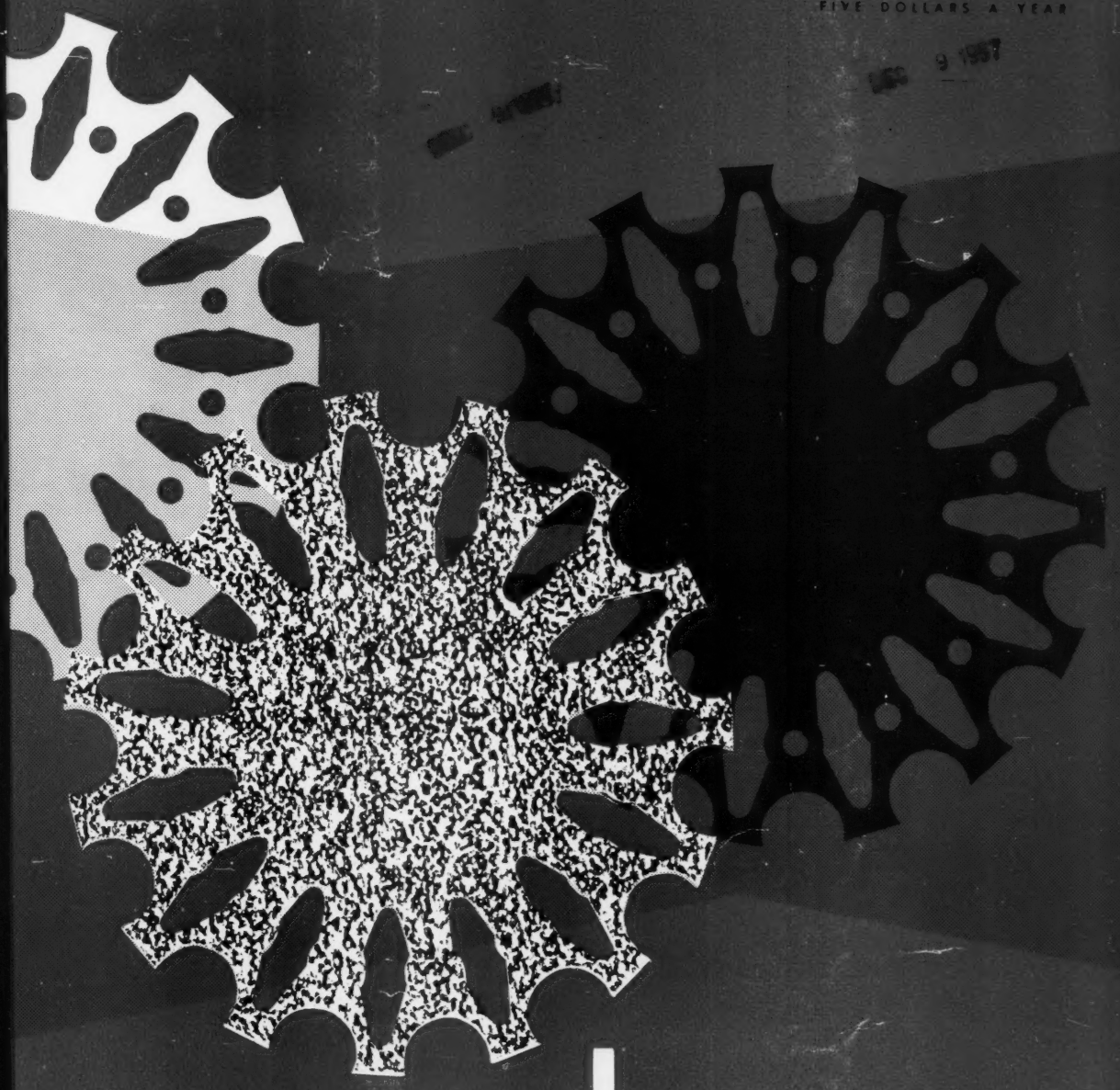
Design Engineering

FIVE DOLLARS A YEAR

DEC 9 1957



Frontier 40-E 39
Glassed Pumps 45
Film thickness measurement 50

December 1957

PUBLISHED BY MACLEAN HUNTER PUBLISHING COMPANY, LIMITED, TORONTO, CANADA

INTRODUCING ALCAN

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For the **FIRST TIME** *anywhere a color anodized aluminum sheet in coils...*

at practical prices!

ALCAN is proud to announce the availability of this new color anodized aluminum sheet, with one side anodized in continuous form. It is an all-Canadian development, offered at far lower cost than has previously been possible with any anodizing process.

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Please send me informative brochure, with samples, giving complete details of your new "COLORCOIL" continuously anodized aluminum sheet.

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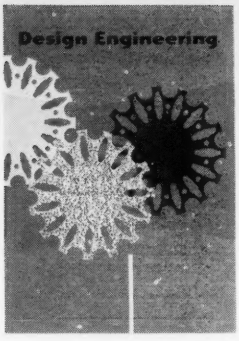

Design Engineering

VOL. 3 DECEMBER 1957 No. 12

This month's cover

Appropriately in tune with the Christmas season, our December issue sports a trio of what might be snowflakes. In fact they are nothing of the kind. They relate to one of our inside stories on an aluminum alloy and are silhouetted castings made for the canning industry. See page 39.

Design Engineering

MEMBER

CCAB

Authorized as second class mail, Post Office Department, Ottawa.

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NORANDA TELLURIUM COPPER

Offers high conductivity plus good machinability

For machined parts that must have high conductivity, specify Noranda Tellurium Copper. This recently developed alloy contains 99.5% copper and 0.5% tellurium. The addition of this small amount of tellurium has the effect of improving the machinability rating to 90, as compared with 20 for electrolytic copper. This important advantage is gained with little effect on other desirable characteristics.

The electrical conductivity of Noranda Tellurium Copper is 90%. Its thermal conductivity compares with that of electrolytic copper in the same range. Hot workability is about the same for both materials, but cold workability of Tellurium Copper is slightly lower.

Precision tolerances can be maintained on screw machines cutting Noranda Tellurium Copper at speeds up to four times faster than with electrolytic copper, and with less wear on tools.

Start cutting your production costs by specifying Noranda Tellurium Copper, as well as other superior Noranda strip, rod, wire and tube products. Call your nearest Noranda Sales Office for immediate service.

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Design Engineering

Inside

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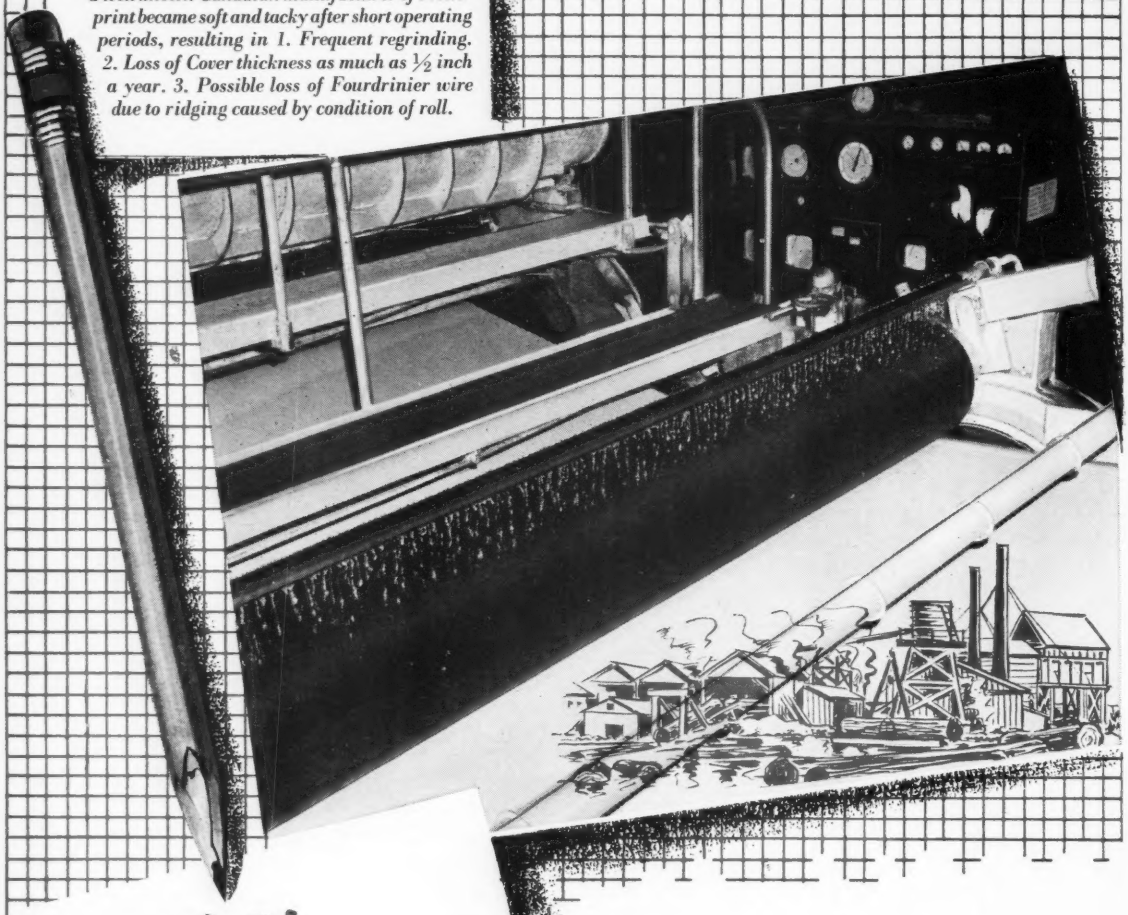
Allen B. Lohr—he wrote the article on glassed pumps—has spent more than thirteen years in Goulds Design Engineering Section. His design ability and experience are reflected in the Goulds-Pfaudler glassed pump and the many other new centrifugals developed by Goulds Pumps, Inc., since World War II. Previous to joining the company in Seneca, N.Y., he was employed by the Union Steam Pump Company, Battle Creek, Michigan and the Clarege Fan Co. of Kalamazoo, Michigan in a similar capacity. His spare time is devoted to the trout in Cayuga Lake. So far this year, fifty-five have fallen prey to his hook, line and sinker.

A. N. Gustafson, who wrote the article on dry compressed air, has been Chief Engineer fro Schramm, Inc. since 1917. In this capacity he has been responsible for many developments, such as Unistage compressors, the mechanical inlet valve and the interchangeability of engine and compressor parts. He is a member of SAE and served for many years on the technical committee of the Compressed Air Institute which was instrumental in preparing several editions of the Compressed Air Handbook. Mr. Gustafson contributed consistently to the thinking of that committee.

Ants Piip (Eddy currents that tell the thickness) was born in Estonia and studied electrical engineering there and in Sweden. He obtained his MSEE from Notre Dame in the early 1950s, did additional post-graduate work in physics and taught in the electrical engineering department. He is now development engineer with the Boonton Radio Corp. He has considerable research experience on ultrasonics, underwater sound, radiobeacons and other navigational instruments. For hobbies he lists photography, astronomy, classical music, fishing and travel. He is married to a biochemist and has 3 children.

Problem:

Previous covers of Couch Presser Rolls used by a well known Canadian manufacturer of Newsprint became soft and tacky after short operating periods, resulting in 1. Frequent regrinding. 2. Loss of Cover thickness as much as ½ inch a year. 3. Possible loss of Fourdrinier wire due to ridging caused by condition of roll.



Solution:

More than a year ago Dominion Rubber supplied a 1½" cover compounded of Polysar Krynac rubber. The surface of the cover has withstood abrasion, high speed operation and the effects of pitch, wood resins and solvents generally present in newsprint stocks. The use of Polysar Krynac has successfully solved this problem.

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Polysar Krynac is a most highly specialized type of nitrile rubber. Its development was preceded by a need. Now it is one of the family of Polysar rubbers that are serving countless industries.

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Reports

News in brief from the world's producers

Hush on postdriving

Pet peeve of wartime wiring parties has been the task of trying to drive angle irons "silently" so as not to give themselves away.

Word from Ottawa has it that this apparently impossible job is now possible, thanks to project engineer **Alec Fulton.** The device sinks long and short pickets with ease and, even at dead of night, is inaudible at 200 yards. City dwellers might petition humanitarian Fulton to give the construction man's pneumatic drill the same treatment and gain a few million friends out of uniform.

Death to diesel fumes

Second man on our list of "friends of Man" this month is **Dr. Paul H. Schweitzer** of Pennsylvania State University. Seems that Schweitzer and fellow scientists are closing in on the ideal of a fumeless diesel engine. Here's how.

They've developed a model which runs by the injection of 85% of the fuel directly into the combustion chamber. The rest goes in at the air intake valves as a fine mist, says Schweitzer, all exhaust fumes are virtually eliminated.

What Sputnik did

The Russians certainly started something when they launched Sputnik I and then added animal interest at the launching of Sputnik II. One of the newest hopes of the space scientists both sides of the Iron Curtain is resting on the ion rocket engine. According to **C. W. Guy** of Rocketdyne such an engine (developing thrust through the high velocity discharge of ionized particles) would make possible unmanned space vehicles capable of sustained flight and directed orbits about any planet in the solar system. Guy goes on to say that an ion propelled vehicle nicknamed Snooper has already been suggested at a meeting of the American Rocket Society and, cautiously, terms their concept "realistic."

NS (for nuclear ship)

Down from outer space, but still in the science-fiction whirl we've entered in the last few years, is the **NS Savannah.**

Named after the first vessel to cross the Atlantic under steam (that was a mere SS) the Savannah will be an atomic-powered surface vessel to carry cargo and sixty passengers. Paid for out of the U S Treasury, it will be built for the Atomic Energy Commission and the Maritime Commission.

Aerial mammoth

A commercial turbo-prop aircraft, larger than any now flying and with a maximum gross weight in excess of 100 tons, was announced by **Canadair** at the beginning of November.

The Montreal company is developing this plane (basically a Britannia?) in both commercial and military versions.

In its commercial versions, the CL-44 is being offered in passenger, cargo and combination variants. Deliveries will begin in 1960. In the "thrift" class, the plane is designed for 154 passengers. Fitted for tourist class, it can seat 123. As an all-cargo plane, it has a payload of 35 tons and can be converted to passenger use in 4 hours.

Happy marriage?

A sporting chance on the peaceable wedding of the steel and plastics industries may be contained in the news that a British steel firm has announced the successful bonding of a coloured plastic skin to sheet steel in a way that enables it to be pressed, cut and machined without damaging the surface. There are endless applications for such a finish in the automotive, household appliance and office furniture fields alone. Farewell to those big repair bills in future auto scrapes. Just kick the fender back into shape, hustle out the colour-matched tube of plastic and, after rolling it on, smooth and polish.

Canada's NRU

By the time our readers see this Reports page of the issue, **Atomic Energy of Canada's** NRU reactor will have been in operation for a full month. It's now undergoing a series of test experiments at low power and this power will be upped after testing to 200,000 kilowatts thermal.

No other known reactor has such a high density of neutrons combined with such a large capacity for experiments. The moderator of the reactor and its primary coolant is heavy water; its fuel is natural uranium.

Exotic fuel

Big news in the field of high energy fuels is the military-industrial project now under way in California to produce **Hi-Cal.** This fuel, a combination of boron carbon and hydrogen, claims 50% more energy per gallon than conventional petroleum fuels. In a liquid form, a clear amber in colour, it is easy to handle and transport.

Next month in Design Engineering

JANUARY

Eastman adhesive—An unexpected result leads to the development of a new liquid adhesive with a rapid set-time and high strength.

Carbide tools—An article on "throw away" solid carbide insert holders for machining metals.

Harmonic drives—This principle makes use of controlled waves of deflection to produce powerful rotary or linear forces.

Ceramoplastic insulation—These materials and glass-bonded mica possess many of the best features of the plastics and the ceramics.

Marine propeller—Estimating propeller performance when it is placed at one end of a long flume.

The CL-41—Canadair's basic jet training aircraft.

Warner brake—A new line of brakes that combines high torque and fast cycling with stopping ability if the power fails.

Dust collectors—Proper dust control boosts quality, cuts costs.

Belt conveyors—When is it advisable to use dual motor drive?

ATLAS STEELS

ATLAS STEEL NEWS

TOOL STEELS • HIGH SPEED STEELS • MINING DRILL STEELS • SPECIAL PURPOSE STEELS • STAINLESS STEELS

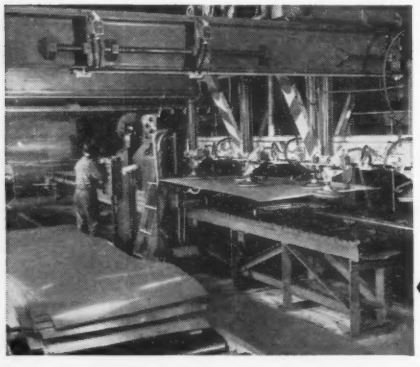
"QUALITY IN QUANTITY" IS KEYNOTE OF ATLAS STAINLESS EXPANSION PROGRAM

Atlas Steels Limited will spend some $5 million this year to improve plant facilities, and a healthy percentage of this amount will go to expand and streamline stainless production. Reason: enterprising fabricators have now developed more than 100,000 uses for this remarkable metal in both industrial products and consumer goods. As Canada's only basic producer of stainless, Atlas is keeping pace with this country's growing demand.

Important units being added to the already impressive set-up for stainless strip production at Atlas include a second continuous anneal and pickle line similar to the one shown at right, and another Sendzimir cold reduction mill.

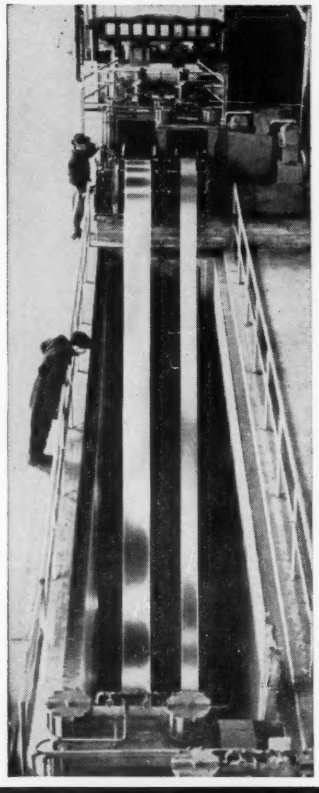
In addition, a new roller hearth annealing furnace will more than double annealing capacity in the stainless sheet mill. This will contribute to improved sheet quality by preserving a superior surface finish during the annealing operation.

With this emphasis on increased production, of course, goes equal emphasis on maintaining highest quality standards in all forms and grades of Atlas stainless steels . . . standards that have given these completely made-in-Canada products a reputation second to none in the world.

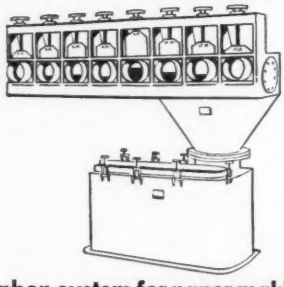


2000 miles of stainless strip per year rolls off this Atlas-designed continuous anneal and pickle line in the fabulous "Miracle Mile" plant at Welland. A second similar line is now nearing completion.

Newest equipment for handling sheet and plate uses rubber suction cups to move stainless to and from mill safely and quickly.



WHAT'S NEW IN STAINLESS products for industry:

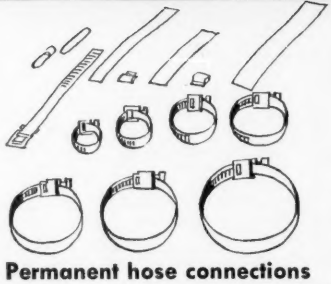


Syphon system for paper making

Seen here are the manifold and header units of a typical Poirier Baromatic Syphon System which is employed to extract water from paper stock. Made of Atlas type 304 stainless steel to resist corrosion and erosion—plus no moving parts feature—means extremely low maintenance.

Largest all-stainless brew kettle

Carlings Limited have installed Canada's largest stainless steel pressure brew kettle in their Montreal Plant. Features include automatic controls to keep boiling beer at constant temperature. Built by Coulter Copper and Brass from Atlas Type 304 Stainless Steel the kettle has a maximum capacity of 610 barrels.



Permanent hose connections

Hamilton Clamp and Stampings Limited insisted on Atlas Stainless Steel for their new, strong and permanent Seal-Tite Clamps. Atlas type 301, .025" thick coils are used for band sections, with type 302, .042" thick strips for housing and saddle section. This use for stainless steel eliminates rust and corrosion problems common to fasteners made of other materials.

ATLAS STEELS LIMITED

WELLAND, ONTARIO

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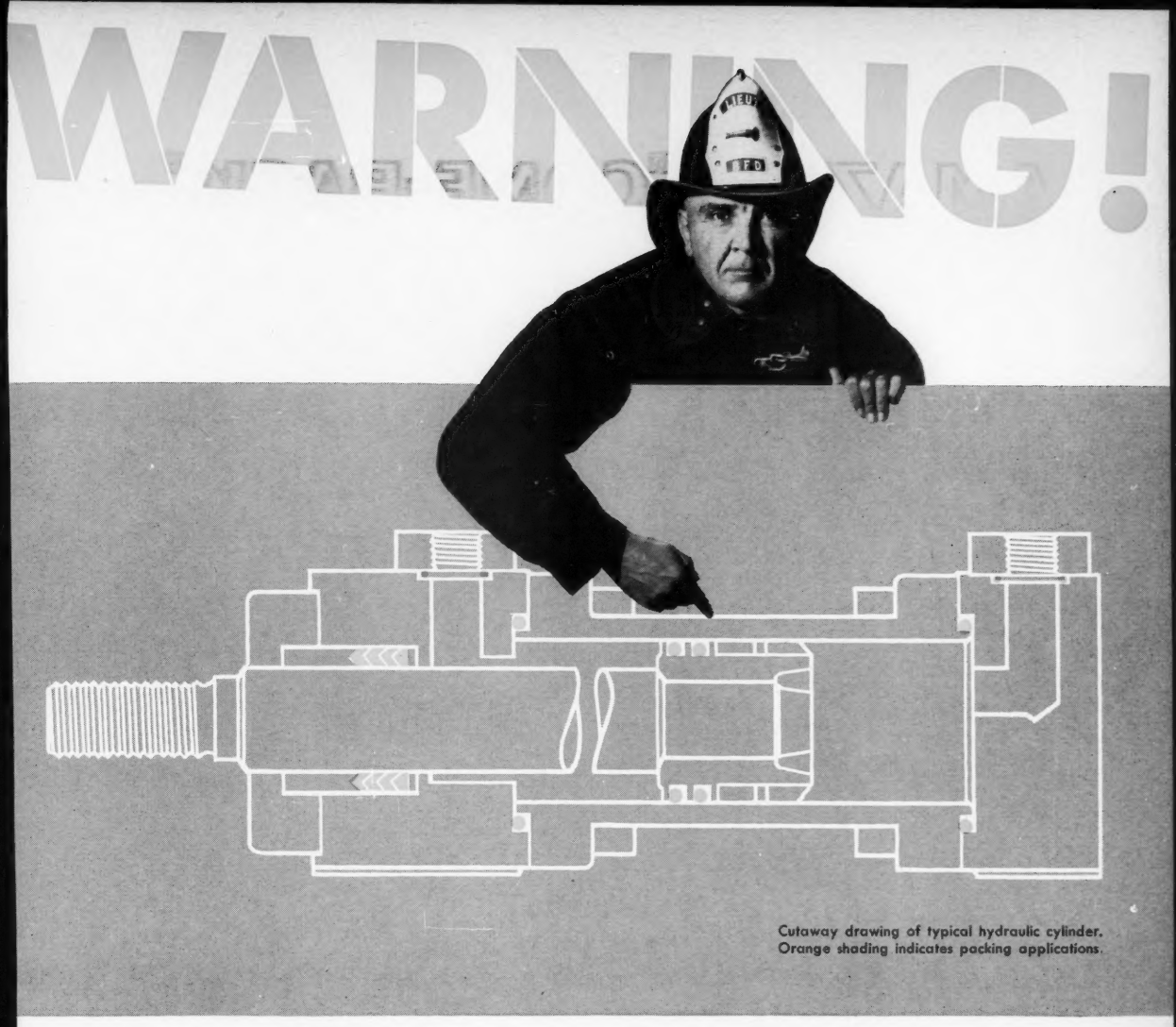

Cutaway drawing of typical hydraulic cylinder. Orange shading indicates packing applications.

WHEN YOU CHANGE TO A FIRE-RESISTANT HYDRAULIC FLUID, CHANGE PACKINGS, TOO!

Here's why: Many fire-resistant fluids are highly destructive to the common rubbers used for packing mineral base oils.

The Garlock "ORANGE LINE" of packings has been developed specifically, and ONLY, for packing *phosphate ester* type fire-resistant fluids in dynamic applications.

The ORANGE stripe across the packings quickly identifies them as suitable for use against fire-resistant fluids. Butyl Rubber is the base material used in these packings and is *not* compatible with mineral base oils. Therefore the "ORANGE LINE" packings should only be used with the phosphate ester type fire-resistant hydraulic fluids.

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The Garlock "ORANGE LINE" for fire-resistant hydraulic fluids is available in CHEVRON* Packings, KLOZURE* Oil Seals, Split KLOZURES, U cups, flanges, O-Rings, and other forms of the Garlock 2,000 . . . two thousand different styles of packings, gaskets, and seals to meet *all* your needs. It's the only complete line . . . it's another reason why you get unbiased recommendations from your Garlock representative. Call him today or write for further information on recommended packings for use against fire-resistant hydraulic fluids.

Garlock CHEVRON Packing set. Orange stripe quickly identifies packing as suitable for use against fire-resistant fluids.

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GARLOCK

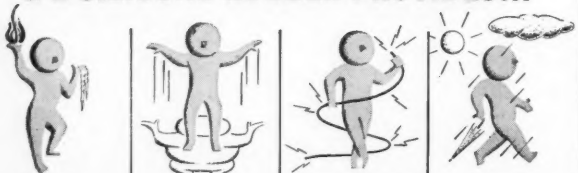
Packings, Gaskets, Oil Seals, Mechanical Seals, Rubber Expansion Joints, Fluorocarbon Products

How can you benefit from the AMAZING "COME-BACK" of G-E SILICONE RUBBER?

Amazing recovery from compression is one of the most useful characteristics of General Electric silicone rubber. In fact, Class 300 silicone rubber has more "come-back" over a wider temperature range than any known rubber! That's why designers now use it where compression is a factor. They know that O-rings and gaskets made of Class 300 silicone rubber *resist compression set*—give *more positive* sealing action for better performance!

Where can YOU use G-E silicone rubber? There's a kind for almost every requirement, classified according to dominant property for easy selection and specification. For example: Class 500 offers flexibility *at 120 F below zero!* Class 700 provides serviceability *up to 600 F!* Which class of G-E silicone rubber is best for *you?*

G-E SILICONE RUBBER PROVIDES...



Outstanding resistance to extreme temperatures | Superior resistance to compression set | Dielectric strength stable at high temperatures | Unequalled resistance to aging, ozone, weathering

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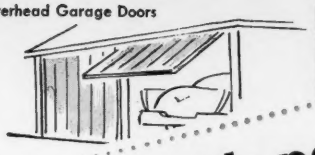
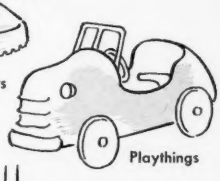
Overhead Garage Doors

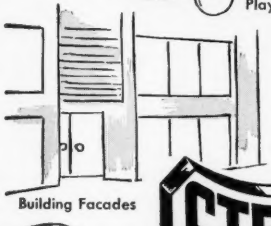


Holds paint like an artist's canvas!

Lawn Mowers



Playthings



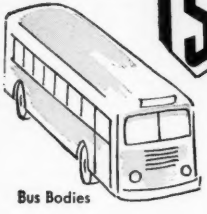
Building Facades

STELCO

"COLOURBOND"

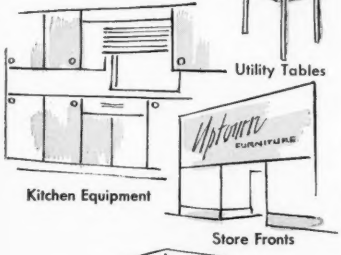
CONTINUOUS

GALVANIZED STEEL SHEETS



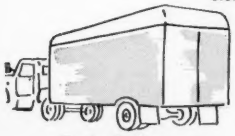
Bus Bodies

Utility Tables



Kitchen Equipment

Store Fronts

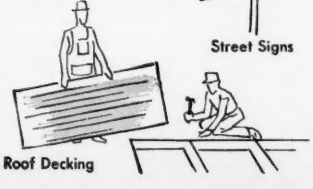


Trailer Bodies

Picnic Coolers

Fishing Tackle and Tool Boxes

Street Signs



Roof Decking

The coating of pure zinc on Stelco's new "Colourbond" Continuous Galvanized Steel Sheets is applied by an exclusive technique developed by Stelco . . . it produces a soft lustre finish, perfectly suited to the close adhesion of paint and particularly acceptable when a bright surface spangle is not desirable.

No surface preparation is necessary, and no primer coat needed.

As with all other galvanized sheets produced by Stelco's patented continuous galvanizing process, the bond between the zinc and the steel is so tight that the sheets can be worked or formed to the limits of the base steel itself, without any sign of cracking or peeling of the zinc coating.

For every product or building application where a painted surface is required to combine with an anti-rust, anti-corrosion surface use Stelco "Colourbond" Galvanized Steel Sheets — available now, in sheets or coils.

For full information and metallurgical service, contact any Stelco Sales Office.

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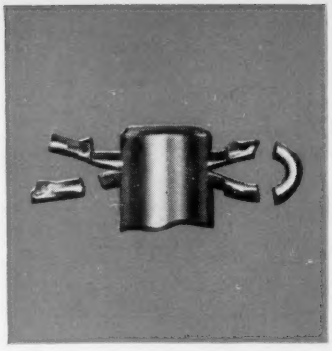
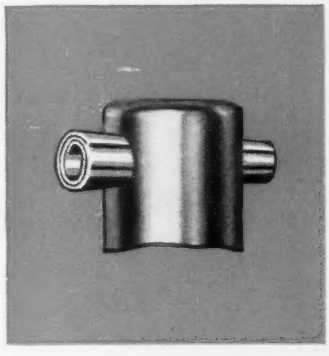
57071.A

Spirol Pins in Morse Roller Chain resist vibration, absorb shock.



Standard heat-treated cotter pin fails after only 3 hours on fatigue tester. Failure in use means costly downtime.



Spirol Pin shows no sign of fatigue after 50 hours on tester. And it won't shake out or break off like cotter pins.

Another Morse advantage for Canadian users . . .

SPIROL PIN FASTENERS AT NO EXTRA COST . . . A MORSE ROLLER CHAIN EXCLUSIVE

Spirol Pins outlast any other fastener on the market! And they are now featured on Morse Roller Chain at no extra cost.

Spirol Pins resist vibration and shock—won't shake loose or break. These stronger fasteners cut down-time.

Spirol Pins are interchangeable with cotter pins on all Morse Roller Chain now in use. They are easy to install—require no special tools.

Morse Roller Chain has longer service life built in. Specially treated, precision-finished steel parts withstand shock and fatigue . . . reduce operating and maintenance costs.

These are the reasons you can depend upon Morse Roller Chain. So, call your Morse Distributor today for *all* your power transmission needs. His name is listed in the Yellow Pages of your telephone directory. Or write: *Morse Chain of Canada, Ltd., Simcoe, Ontario.*

IN POWER TRANSMISSION
THE TOUGH JOBS COME TO

MORSE

*Trademark

HOW THE SILICONES MAN HELPED...
Stop Costly Water Damage In
HOW THE SILICONES MAN HELPED...
Deliver a Hot Blast to Cold Jets!
HOW THE SILICONES MAN HELPED...
Light up the life of a double-decked commuter
UNION CARBIDE
SILICONES

HAVE YOU MET THE

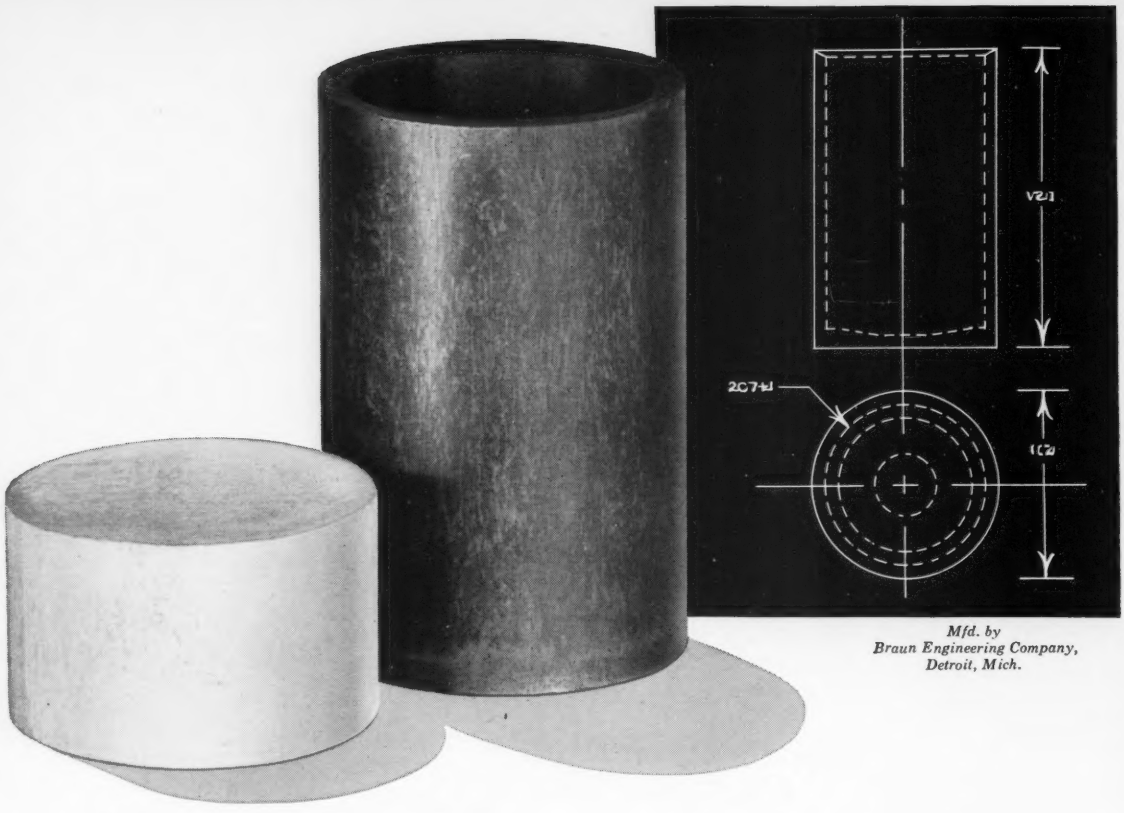
SILICONES MAN ?

He'll tell you the story of the "impossible" rubber that helps deliver a hot blast to cold jets . . . or the case of the 3600 mph wind tunnel. Perhaps you'll want him to tell how he helped seal a delicate gyroscope . . . or show you the brick that floats. Here's a man with a thousand success stories about UNION CARBIDE Silicones.

But the Silicones Man is in reality many men—in sales engineering, technical service, research, and development—all working together as the Silicones Division of UNION CARBIDE. Between them they possess tremendous knowledge about the wonderful world of silicones. There's a Silicones Man in most major cities. Put him to work on your problems today. For a complete description of many silicone products, write for the booklet "Look to UNION CARBIDE for Silicones."

BAKELITE COMPANY
Div. of Union Carbide Canada Limited
40 St. Clair Ave. E., Toronto 7, Ontario

UNION CARBIDE
TRADE-MARK
SILICONES



Mfd. by
Braun Engineering Company,
Detroit, Mich.

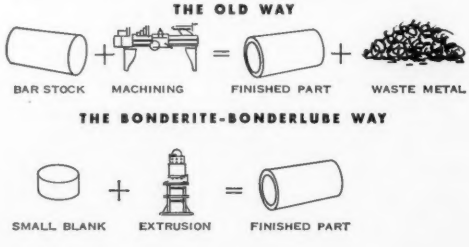
EXTRUDED... *and sold for less than the raw stock used to cost!*

Cold extrusion of steel means big reductions in material, machinery, and time. Frequently, as in the case of the automotive motor mount above, the part is made by cold extrusion for about the cost of the raw metal used in conventional methods.

More and more, manufacturers are turning to cold extrusion as a cost cutting, simplified method of making quality parts. Machining is cut to a bare minimum and scrap virtually disappears. "Impossible" jobs are being mass produced at high rates and a lot of the "impossibles" have become production runs only because of Bonderite and Bonderlube.

These two remarkable aids in cold extrusion make metal flow like magic. More severe deformations are possible. Tool and die life are multiplied. Rejected parts are few and far between. Production speeds are greatly increased. Smooth finishes are easily achieved and maintained.

The Parker cold forming staff can give you expert help in the technique of cold extrusion.



Since 1914—leader in the field

PARKER RUST PROOF COMPANY
OF CANADA, LTD.
REXDALE BLVD., REXDALE (TORONTO) ONTARIO.

BONDERITE corrosion resistant paint base

BONDERITE and BONDERLUBE aids in cold forming of metals

PARCO COMPOUND rust resistant

PARCO LUBRITE wear resistant for friction surfaces

TROPICAL heavy duty maintenance paints since 1883

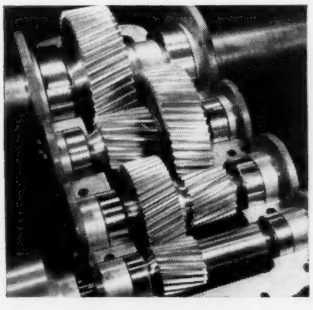
**Bonderite, Bonderlube, Parco, Parco Lubrite—Reg. U.S. Pat. Off.*

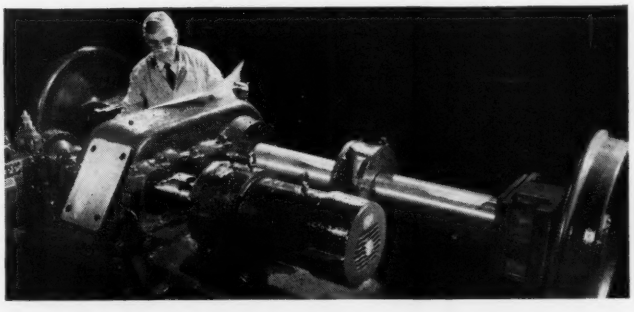
Special Self-Propelled Drive Mechanism Illustrates Engineering Skill of Hamilton Gear

When Dominion Foundries and Steel, Limited required a new type of drive mechanism for a number of self-propelled ingot mould transfer cars, they called in Hamilton Gear. The challenging problem: to move a 300 ton gross weight at a track speed of less than one mile an hour using as a source of power a 10 H.P. standard speed electric motor. The total gear ratio between the motor and the car axle is 186 to 1.

Hamilton Gear designed and built the compact assembly shown below, which incorporates an axle of the transfer car and constitutes a completely self-contained drive mechanism. It combines a standard Hamilton Gear motorized speed reducer with a specially engineered helical gear reduction box, interior of which is shown on the lower left.

For this type of unusual and complex custom design work, or for the simplest gear application in any industry, consult with Hamilton Gear. They will gladly work with you on your gear and speed reducer problems.





Hamilton Gear and Machine Co., Limited.

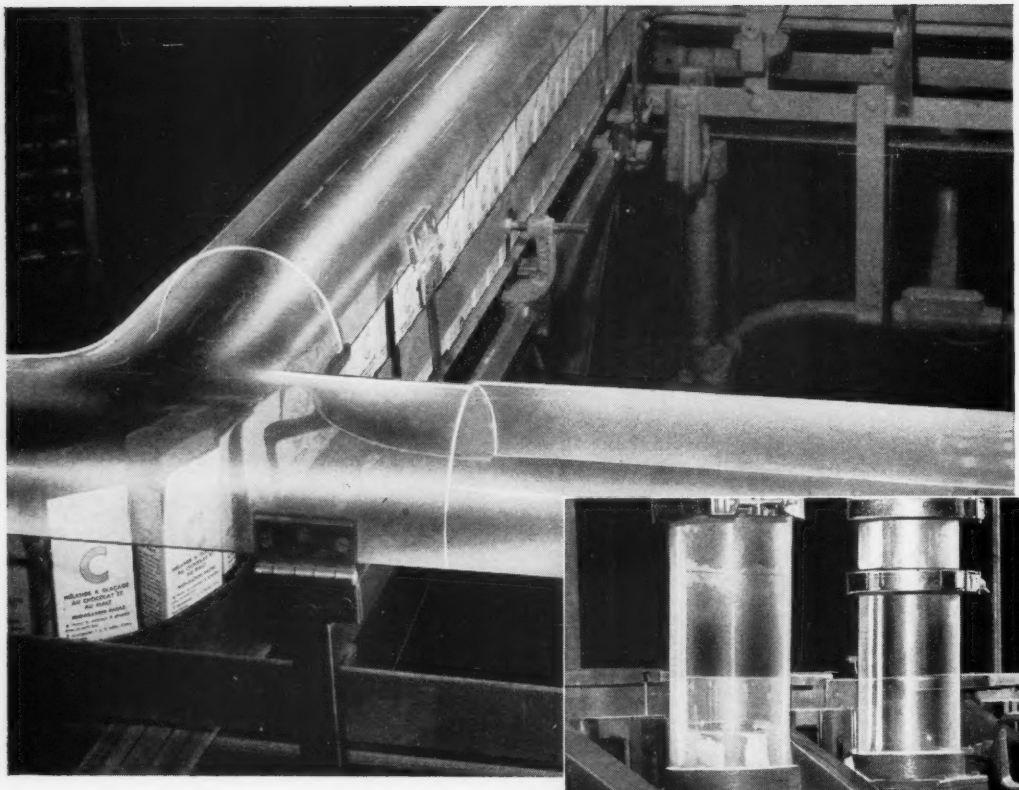
950•990 DUPONT ST., TORONTO 4

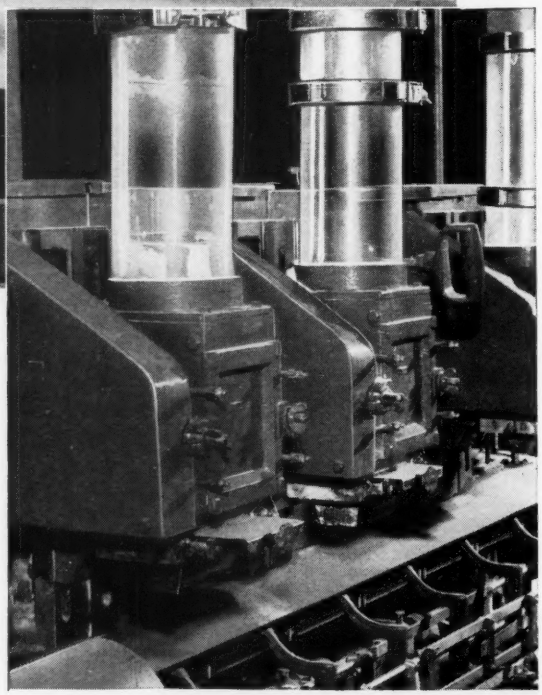
MONTREAL office—6785 Upper Lachine Road
WINNIPEG office—The Cuthbert Company Ltd., 19 MacPhillips St.
EDMONTON office—John H. Ross and Co. Ltd., 6803 - 104th St.
VANCOUVER office—B.C. Conveying Machinery Ltd., 3300 Fraser St.

G-1-57

PLEXIGLAS*

at work in industry!





These photographs taken at the General Mills (Canada) Limited plant in suburban Toronto, show Plexiglas at work in industry.

These covers on the cake-mix filling line allow the operators to constantly check the packages, while dust is kept confined to a small area. The Plexiglas down-pipes allow the operator to see that the cake-mix remains free-flowing at all times.

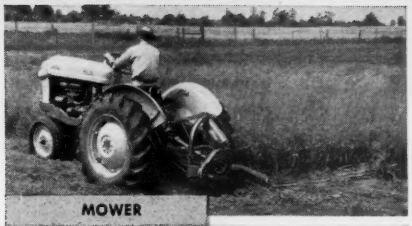
This is but one example of Plexiglas at work, designed by the engineers at General Mills (Canada) Limited.

CRYSTAL GLASS AND PLASTICS LTD.

TORONTO · MONTREAL · WINNIPEG · VANCOUVER

CRYSTAL

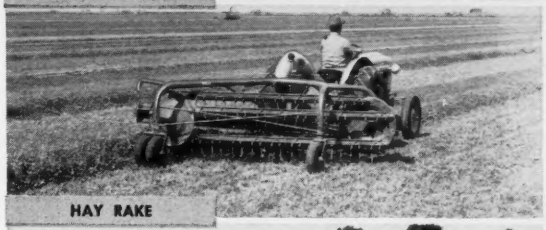
**Plexiglas is a registered trademark of Rohm & Haas*



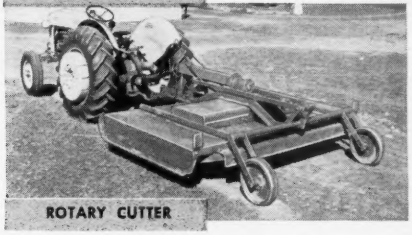
MOWER

MANURE SPREADER

COMBINE



HAY RAKE



ROTARY CUTTER

HAY BALER

CORN PICKER

Yes, these modern Ford Implements are driven through only 3 sizes of

BLOOD BROTHERS UNIVERSAL JOINTS

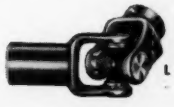
You'll find important advantages in equipping your implement line with fewer different parts. By working with Blood Brothers' engineers, you can enjoy cooperation to help reduce initial costs and minimize your own engineering expense. Purchasing, stocking and parts cataloging problems, too, are simplified.

And because Blood Brothers Universal Joints deliver the trouble-free, long-lasting service farmers expect, your implements have maximum sales appeal.

Be sure you get the advantages of Blood Brothers engineering, performance and prestige . . . write for full information.

35 N SERIES

L 14 N SERIES



L 12 N SERIES

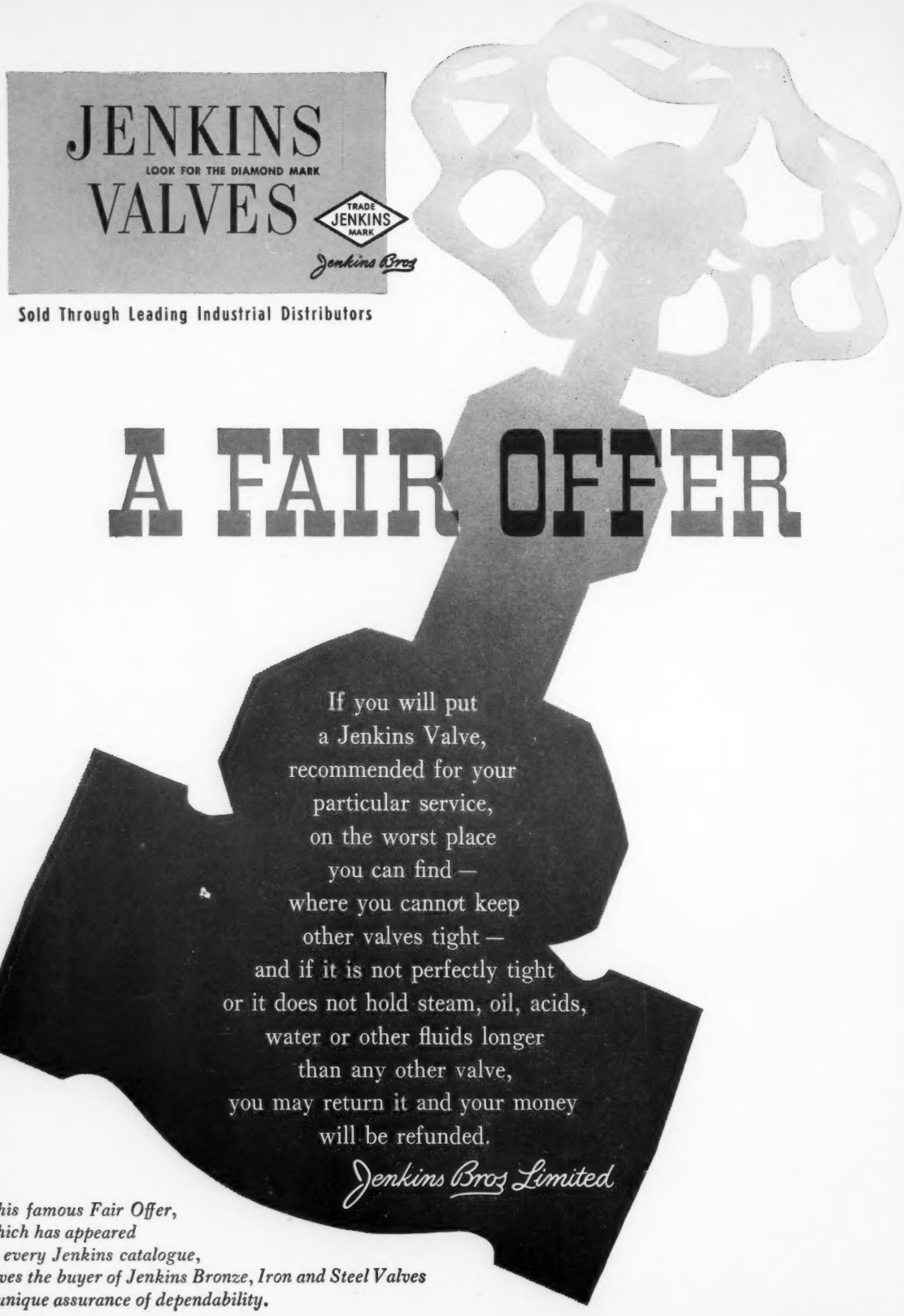
FOR FARM IMPLEMENTS, MORE BLOOD BROTHERS UNIVERSAL JOINTS ARE USED THAN ALL OTHER MAKES COMBINED

BLOOD BROTHERS MACHINE DIVISION

ROCKWELL SPRING AND AXLE COMPANY

ALLEGAN, MICHIGAN

UNIVERSAL JOINTS AND DRIVE LINE ASSEMBLIES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VALVES
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will be refunded.
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in every Jenkins catalogue,
gives the buyer of Jenkins Bronze, Iron and Steel Valves
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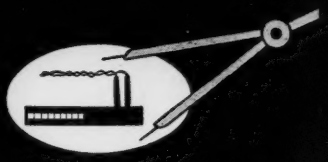


in industry

NEOPRENE fire hose is good as new after three years in refinery

New neoprene hose with cover of *Dacron* far outlasts conventional cotton-reinforced rubber hose. Latter was deteriorated by oils and acids.

Dragged over rough floors, through oil and chemicals ...still meets safety specifications

"I have never picked up a hose that will equal it," is the endorsement of Karl Pepper, a 25-year fire-fighting veteran and Safety Director at D-X Sunray Oil Company's refinery at Duncan, Oklahoma. Heart of this hose is neoprene; its hide is *Dacron**: neoprene tube for flexibility and resistance to oil and chemicals; cover of *Dacron* for strength and abrasion resistance. In areas where excessive oil contact is encountered the cover is impregnated with neoprene.

This rugged new industrial fire hose weighs only 30 lbs. per 50-ft. length compared to 58 lbs. for the same length of conventional rubber fire hose. It will withstand 500 psi. pressure and 300°F. temperature. Unlike cotton-covered hose, it is unaffected by mildew, and is so flexible it can be tied in a knot without harming it. The hose can be stored all year, as at the D-X Sunray Refinery, in outdoor racks without deterioration.

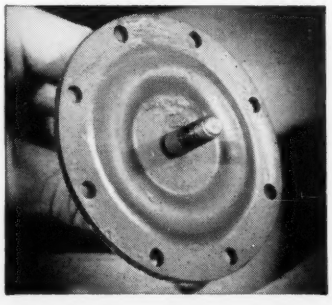
D-X Sunray switched from cotton-reinforced rubber fire hose to overcome the deterioration experienced from acids and oil. Nearly 2500 ft. of neoprene hose with cover of *Dacron* are now in service at the refinery and no maintenance has been required since the first length was purchased in July, 1954.

Fire hose is only one application where versatile neoprene may help cut operating and maintenance costs. Its service record is outstanding where exposure to oils and chemicals, sunlight and weather, or cutting and abrasion would ruin ordinary rubber. Tank linings, gaskets and belting are but a few uses. Mail coupon for full information.

*Du Pont's trademark for its polyester fiber.

Exposed to 66° Be. sulfuric acid —HYPALON diaphragm gives 2 years' perfect service on acid pump

In November, 1954, a HYPALON diaphragm was installed in a proportioning pump in the plant of Fields Point Mfg. Corp. at Providence, R. I. Since that time it has been on continuous service handling 66° Be. sulfuric acid. Before the use of HYPALON, diaphragms were oxidized and embrittled by the strong acid and had to be replaced every few months.



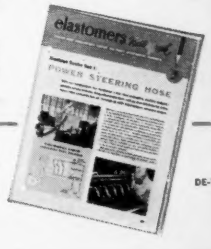
The diaphragm flexes about 26 times a minute through a ¼-in. stroke and is fabric-reinforced for 125 psi. service. The sulfuric goes from the pump to a stoneware tower where it dries chlorine gas from electrolytic cells.

HYPALON is a new Du Pont synthetic rubber which is noteworthy for its resistance to oxidation — by chemicals, heat, ozone, sunlight and weather. It is being used in the chemical industry for tank linings, acid hose, colored protective coatings, gaskets, valve inserts and pump parts. For more information about HYPALON, just mail the coupon.

DU PONT CANADA

HYPALON *is a registered trademark of E. I. du Pont de Nemours & Co. (Inc.)*

MAIL THIS COUPON TODAY!



☐ I am particularly interested in _____

☐ Please add my name to the mailing list for your free publication, the ELASTOMERS NOTEBOOK.

DE-12

Du Pont Company of Canada (1956) Limited,
Chemicals Department Room A-4,
P.O. Box 660, Montreal, Que.

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Firm _____
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Newcomer on the Canadian scene

TYRIL

widens the range of thermoplastics performance

We are proud to introduce Tyril* as the first member of the new family of Dow styrene acrylonitrile copolymers. Tyril is entirely different from any of the familiar Dow thermoplastic moulding materials—its performance will open new horizons in plastics.

The faster cycling and better mouldability of Tyril results in marked economies of production. Tyril has a remarkable balance of physical properties, it is rigid, yields high critical elongation and tensile strength. Tyril provides an improved resistance to heat and to a wide variety of chemicals, organic solvents and food stains.

Tyril lends itself to many applications including, quality tumblers, dinnerware and industrial components requiring toughness and durability.

Tyril is available in natural as well as a wide range of transparent and opaque colours. It has a ready affinity for decorative colours and finishes which should stimulate greater sales.

Capitalize on Tyril! Put the leadership of Dow technical service to work on your production or design problems. For more details, write DOW CHEMICAL OF CANADA, LIMITED, 600 University Avenue, Toronto 2.

PERFORMANCE-PROVED FAMILY OF DOW PLASTICS

*ETHOCEL		EXCEPTIONAL TOUGHNESS	STYRON	777	MEDIUM IMPACT
*STYRON	666	GENERAL PURPOSE		440	HEAT RESISTANT — HIGH IMPACT
	688	EASY FLOW		480	EXTRA HIGH IMPACT
	689	FAST FLOWING FORMULATION		700	HIGHEST HEAT RESISTANCE
	475	HIGH IMPACT	TYRIL		GOOD IMPACT WITH CHEMICAL RESISTANCE

*TRADE MARK

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Every day, engineers make further use of steel tubing in the many products that make our living easier, more comfortable, and more pleasant.
"Standard Tube" supplies finest quality steel tubing to Canadian industry plus an engineering research staff to help meet every requirement with exactly the right material.
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Sheet, Bar, Extrusions, Tube and Wire—available in any quantity.

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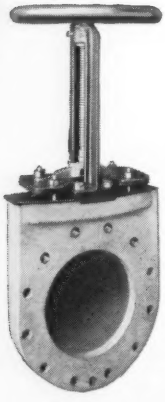
Member of Formed Steel Tube Institute

DESIGN FOR CORROSION RESISTANCE

replace metal with molded polyester



CORROSION-RESISTANT VALVE

withstands attack by strong acids and alkalies in paper mills. Readily absorbs vibration in pump lines, giving longer service life without leakage. Body is molded of glass-reinforced Thermaflow polyester. Designed and used by W. C. Rovang & Associates, Portland, Oregon; molded by Grant and Roth Plastics, Inc., Portland, Oregon.

You can get resistance to corrosion by acids and alkalies superior to stainless steel and Monel—at cost savings of up to 40%—by designing with Thermaflow reinforced polyester molding compounds. These materials also have excellent resistance to many organic solvents. They are stable at temperatures up to 300° F., and comparable in strength to aluminum castings. In addition, they offer you—

- **light weight—specific gravity 1.8**
- **high impact and flexural strength**
- **excellent electrical properties**
- **good surface finish—no machining needed**
- **one-piece production — metal fittings can be molded in place**
- **variety of colors — no finishing needed; paint, if desired, without bonding coat**

Thermaflow materials can be compression or transfer molded on standard presses at temperatures 275-350° F., pressures 400-900 psi. They can be molded readily in large, complex shapes with deep draw and intricate detail. Curing time is relatively short.

Write for data on the many grades of glass fiber and nylon rag reinforced Thermaflow materials, and on molding techniques and applications.

Atlac THERMAFLOW—Trademark, Atlas Powder Company

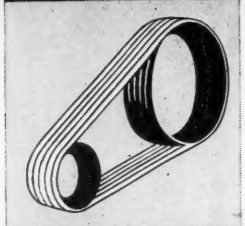
ATLAC THERMAFLOW

ATLAS

ATLAS POWDER COMPANY, CANADA, LTD.
Brantford, Canada

Offices in **MONTREAL, TORONTO, EDMONTON, VANCOUVER**

TEXROPE



DRIVES

NEW adjustable-speed Magi-Key SHEAVE

- positive locking
- greater design hp capacity

HERE'S THE KEY. This combination keylock from disc to hub makes adjustment easy.

Here's an entirely new Allis-Chalmers concept in cast iron adjustable sheave design. It's the newest member of the *Texrope* drive family, the *Magi-Key* sheave!

This new sheave makes it really easy and inexpensive to obtain variable speeds on low-horsepower applications. Here's why:

✓ Handles design horsepower applications from fractional to 13 hp.

✓ Features positive locking between sheave and shaft.

✓ Has combination keylock from disc to hub . . . no more fumbling to get proper tightening.

✓ All rotational torque transmitted through keys.

✓ Key lock won't slip — setscrew can't fly out.

Magi-Key sheaves are available in one and two-groove sizes for either A or B section V-belts. Find out more from your A-C district office or distributor, or write Canadian Allis-Chalmers Ltd., P.O. Box 37, Montreal, Que.

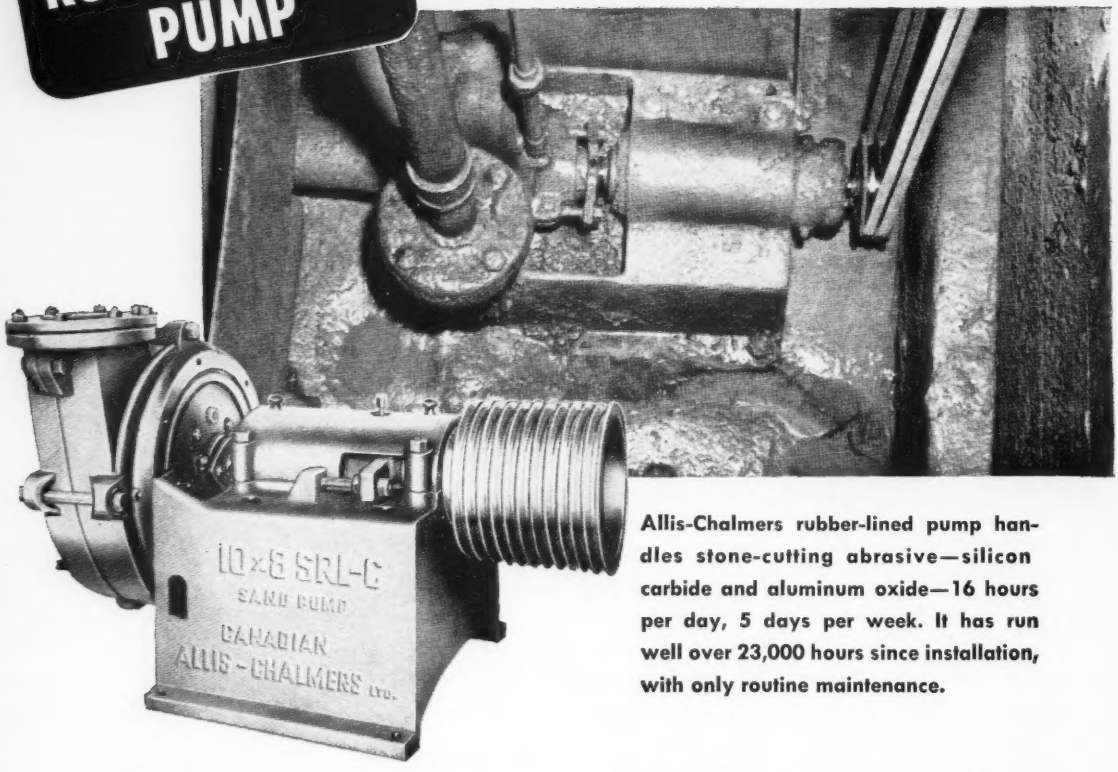
MADE IN CANADA

CANADIAN ALLIS-CHALMERS

. . . OVER 23,000 HOURS and still running!

(Best Previous Pump—1,040 Hours)

ALLIS-CHALMERS RUBBER-LINED PUMP



Allis-Chalmers rubber-lined pump handles stone-cutting abrasive—silicon carbide and aluminum oxide—16 hours per day, 5 days per week. It has run well over 23,000 hours since installation, with only routine maintenance.

PUMPING RECORDS like this are not unusual with the Allis-Chalmers rubber-lined pump. Service life up to 50 times that of the best alloy pumps is common. Pumping costs are greatly reduced because of reduced maintenance and repair costs and also because of fewer production interruptions and less lost production time.

Unique Lining Method

The rubber lining of the Allis-Chalmers SRL rubber-lined pump is bonded to a heavy steel skeleton which is bolted into the casing. This arrangement provides maximum support for the liners but makes them easy to remove.

Each Installation Specially Engineered

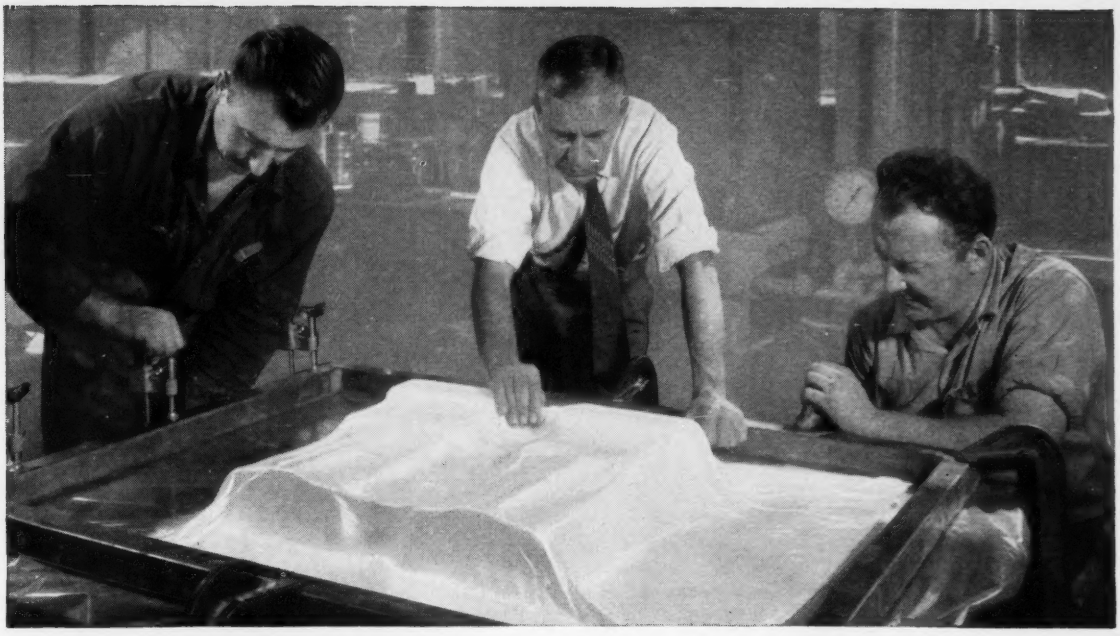
Every pump is individually engineered to provide the best possible performance for the application involved. Special rubber linings of various compounds handle a wide variety of slurries at low cost per gallon pumped.

If you are handling sand, taconite, grinding mill discharge, tailings or any other abrasive slime or slurry and want longer pump life, contact your nearest CA-C Sales Office or write direct to Canadian Allis-Chalmers Limited, P.O. Box 37, Montreal, P.Q.

MADE IN CANADA

CANADIAN ALLIS-CHALMERS

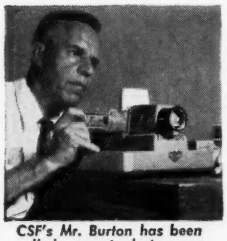
57-P-5



Mr. Harry Burton and his team of pattern-makers vacuum-forming a plastic pattern in CSF's Pattern Shop.

How "Mr. B's" Plastic Revolution Gave a Manufacturer

30,000 CSF castings from a single pattern



CSF's Mr. Burton has been called upon to lecture on his methods at Foundries throughout Canada and U.S.A.

At Canadian Steel Foundries we're particularly proud of 'our Mr. B'. Mr. B — Harry Burton, Pattern Shop Foreman — developed a process that helps keep clients' costs down when casting are required in quantity . . .

Wood and metal have long been recognized as the pattern-maker's standard materials. For some kind of castings they're still the best. But for *quantity* casting, Mr. B's CSF Pattern Department developed the use of epoxy resin plastics. Resistance of these plastics to the sand used in casting is astounding — far better than metal or wood.

The result? Many more castings can be made to fine tolerances before renewal of the pattern. One CSF plastic pattern gave a customer *30,000 castings*, and it's still going strong. Recently, Mr. B has developed his new process still further. By forming his plastic patterns in a "vacuum bag" of polyvinyl alcohol, he's been able to make dense, void-free patterns and core boxes of enormous strength. One advantage is sharply reduced pattern maintenance costs.

Harry Burton is remarkable — a true master of the craft of pattern-making. But he typifies what CSF offers you: the spirit of creative research that makes a challenge out of problems — and then overcomes them. This spirit extends from design to finished product at CSF. Get CSF on *your* team soon — CSF Sales Engineers will consult with your own personnel at no cost to you.

CANADIAN STEEL FOUNDRIES (1956) LIMITED

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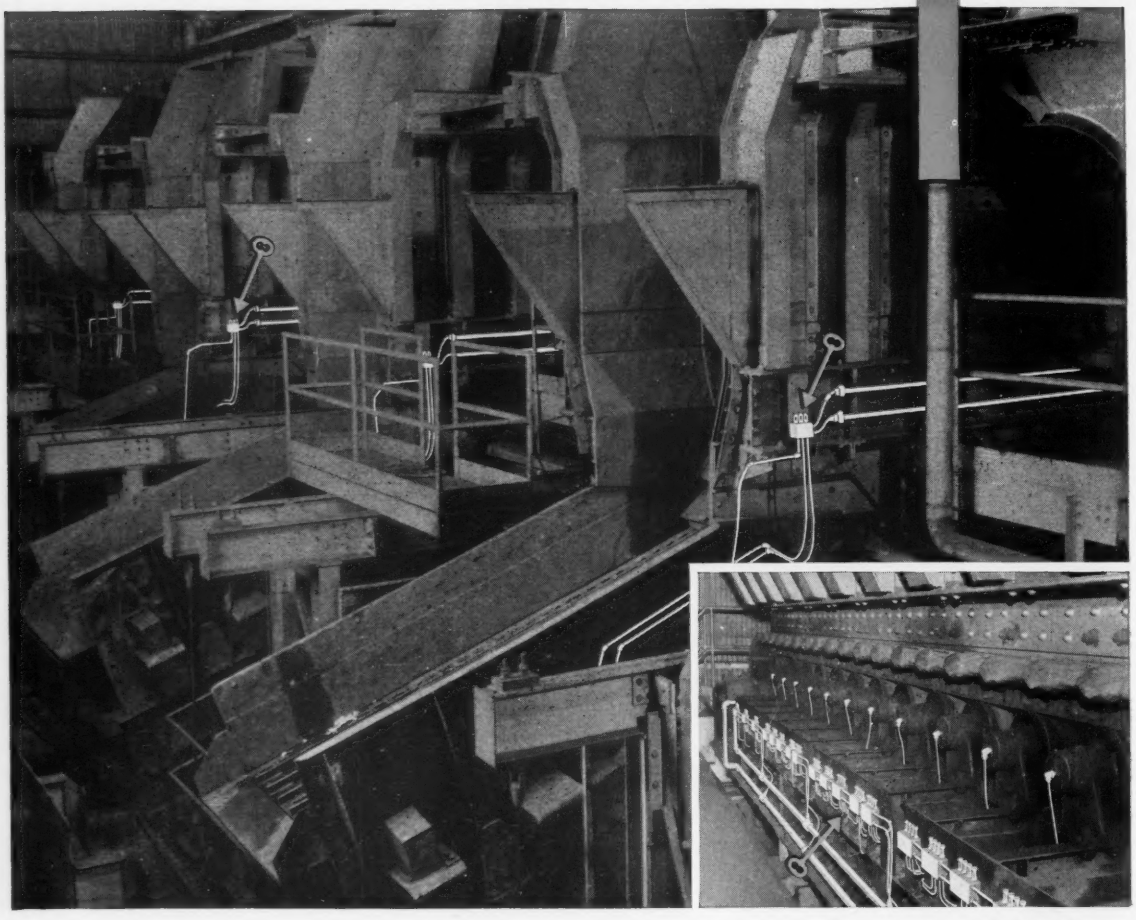
Member: A. V. Roe Canada Limited and The Hawker Siddeley Group

Iron ore plant protects 2,000 bearings on crushers and pan feeders with Farval

FARVAL—
Studies in Centralized Lubrication
No. 193



KEYS TO ADEQUATE LUBRICATION—
Wherever you can see these Farval manifolds, dual lubricant lines and central pumping station, you know a machine is being properly lubricated.

Above—four pan feeders and their screens at the Sherman Crushing Plant. Below—close-up of Farval valves serving a feeder.

CRUSHING and handling iron ore creates extreme pressures on processing equipment; so proper lubrication is vital to prevent overheated, ruined bearings, with consequent work stoppage, lost production and needless maintenance expense.

To ensure dependable, adequate lubrication of their equipment, Oliver Iron Mining's Sherman Crushing Plant at Hibbing, Minnesota, installed Farval Centralized Lubrication. A total of 2,000 bearings on crushers, pan feeders and screens are served from two Farval automatic pumping stations.

By protecting equipment, Farval saves labor—helps to maintain production schedules. With Farval on the job, oilers are kept out of the dangerous machine areas—a safety factor. Lubricant lines reach bearings even in the most inaccessible places to apply oil or grease in measured quantities as frequently as desired.

Farval can serve any machinery builder or owner—efficiently, economically, permanently. For details, write for Bulletin 26-S. Peacock Brothers Limited, P.O. Box 1040, Montreal 3, Que. Branches in Sydney, Toronto, Sudbury, Winnipeg, Edmonton, Calgary, and Vancouver.

FARVAL
CENTRALIZED SYSTEMS OF LUBRICATION

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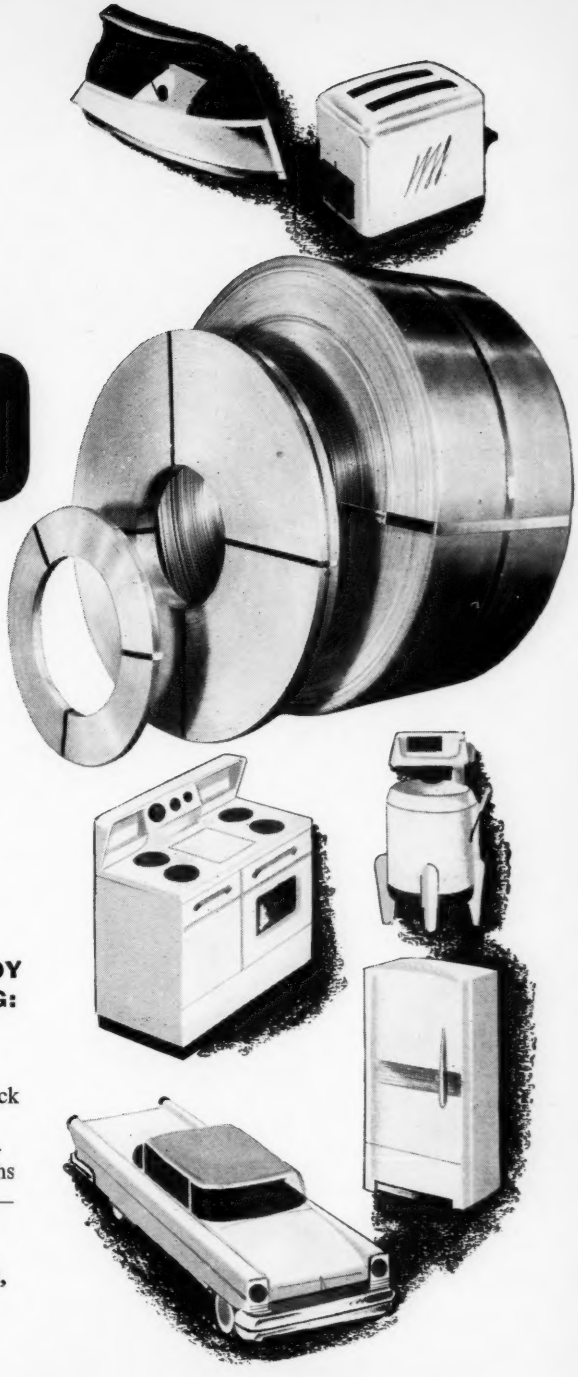
PEACOCK BROTHERS LIMITED

For an iron or an automobile—
for an oil line pipe or a ship

FLAT ROLLED STEEL

must be of suitable specification
properly processed for each
individual manufacturing requirement.



ALGOMA STEEL CORPORATION PRODUCES HIGH QUALITY FLAT ROLLED STEEL IN CARBON AND ALLOY GRADES, INCLUDING THE FOLLOWING:

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- Hot Rolled Pipe Skelp—mill or bevel edge—black or pickled and oiled—in coils or cut lengths
- Hot Rolled Sheets and Strip—mill or slit edge—black or pickled and oiled—in coils or cut lengths
- Cold Rolled Sheets and Strip—mill or slit edge—dull or bright (lustre) finish—Nos. 1,2,3,4 and 5 Temper—in coils or cut lengths
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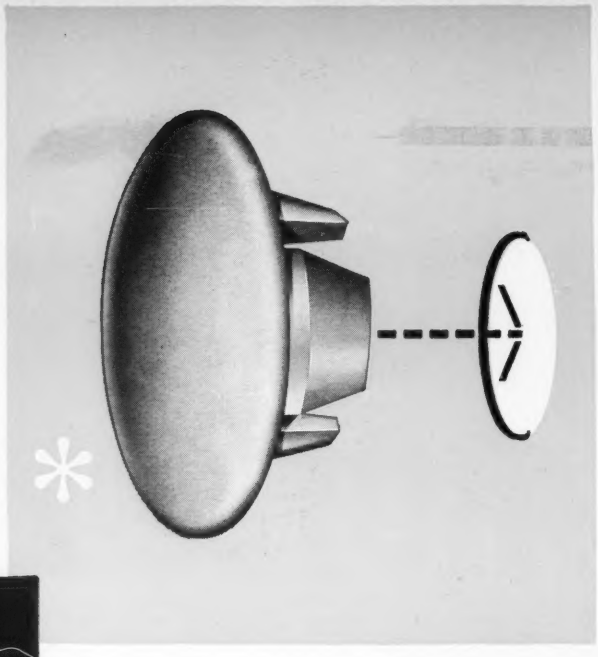
Good looks count

. . . and you can count on improved product appearance with

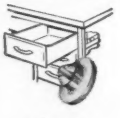
Plasti-Plugs®



Plug production holes

Ventilation plugs

Cover access holes



Silent drawer glides

Metal kitchen cabinets with unsightly production holes showing? Not if Fastex Plasti-Plugs (one piece, self-retaining hole plugs) are used! Snapping-in with a light touch of the finger, Plasti-Plugs are available in 45 standard sizes, in colors to match every product. Low in cost to buy and apply, Plasti-Plugs do double duty too—can be used for dust protection, friction glides and as replaceable plugs. Special moisture-sealing plugs may also be had. Made of polystyrene, nylon or vinyl, they're non-corrosive, always good-looking.

7-41

SHAKEPROOF FASTEX

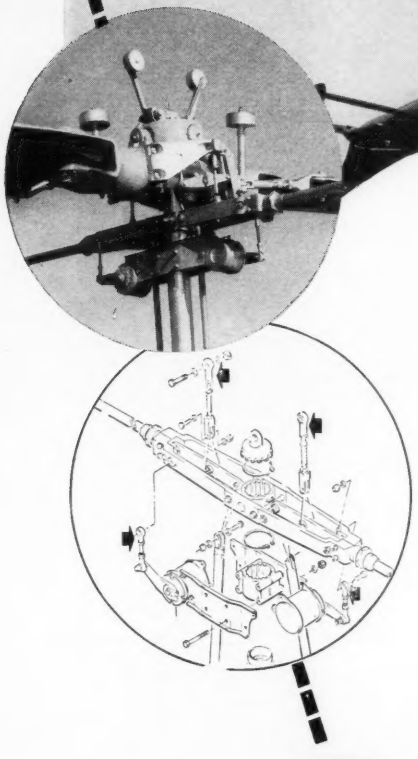
"FASTENING HEADQUARTERS"®

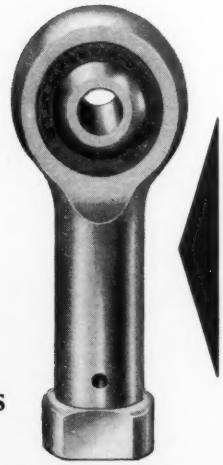
Write for free catalog.

45 standard sizes listed . . . tells how easily you can "snap in" Plasti-Plugs by Fastex.

DIVISION OF CANADA ILLINOIS TOOLS LTD.

67 SCARSDALE ROAD • DON MILLS, ONTARIO





THE NEW "BELL RANGER" HELICOPTER USES HEIM UNIBAL ROD ENDS

Model 47-J is the latest helicopter to be introduced to the commercial market by Bell Helicopter Corp., and has been named the Bell Ranger. It is a four-place, executive type machine with a deluxe interior or a series of quick-change cabin arrangements for cargo, litter, and internal hoist configurations.

HEIM Unibal Rod Ends were chosen for the linkages in the carburetor heat and mixture control installations, and in the main rotor stabilizer bar assembly. The rods link hydraulic dampers to the bar, which provides exceptional stability to the flight characteristics of Bell helicopters, acting like a gyroscope and, through mixing levers, keeps the rotor plane of rotation in its pre-established flight path.

THE HEIM *Unibal* is the spherical bearing which corrects misalignment in every direction because of the universal movement of the ball — Reduces friction and lost motion in linkages — Eliminates the effects of vibration — Lowers assembly costs because of its quick and easy installation — Carries heavier loads.

Perhaps Heim can help solve — or simplify — your linkage problems. Feel free to write. Be sure each engineering and purchasing department has a Heim catalog.

R&M BEARINGS CANADA LTD.

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WELDED DESIGN *makes*

automatic machine

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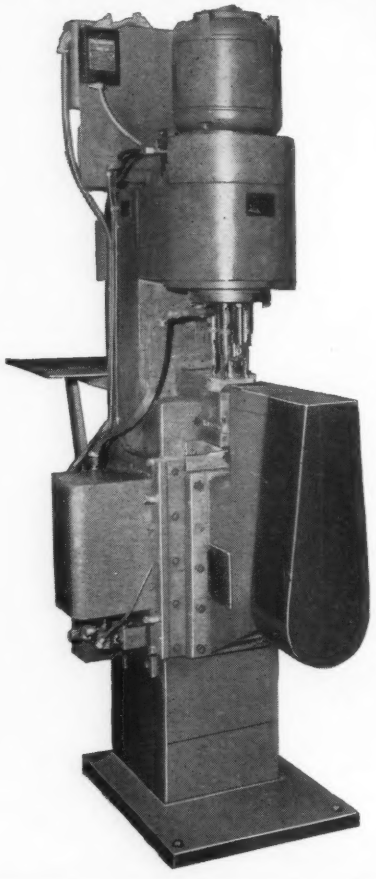

Shown above is a machine developed by L. J. R. Sanders Engineering Company, Galt, Ontario, for drilling and slotting hardwood bearings.

Sound principles of design using welded-on reinforcements, ribbing and diagonal bracing has now completely solved the vibration problem in welded plate construction for this manufacturer.

When the properties of steel in terms of tensile strength and moduli of elasticity are taken into account welded design can result in a weight saving of at least 50% over cast iron.

At the same time savings in material costs up to 85% can be made and allowing for additional fabricating cost, an overall saving of 50% is often effected.

Write for "Elements of WELDesign" issued quarterly as a guide to better products at lower cost. Ask for particulars of Lincoln's WELDesign Course arranged especially for designers.

LARGEST MANUFACTURER OF ARC WELDING EQUIPMENT IN THE WORLD

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VICTOR

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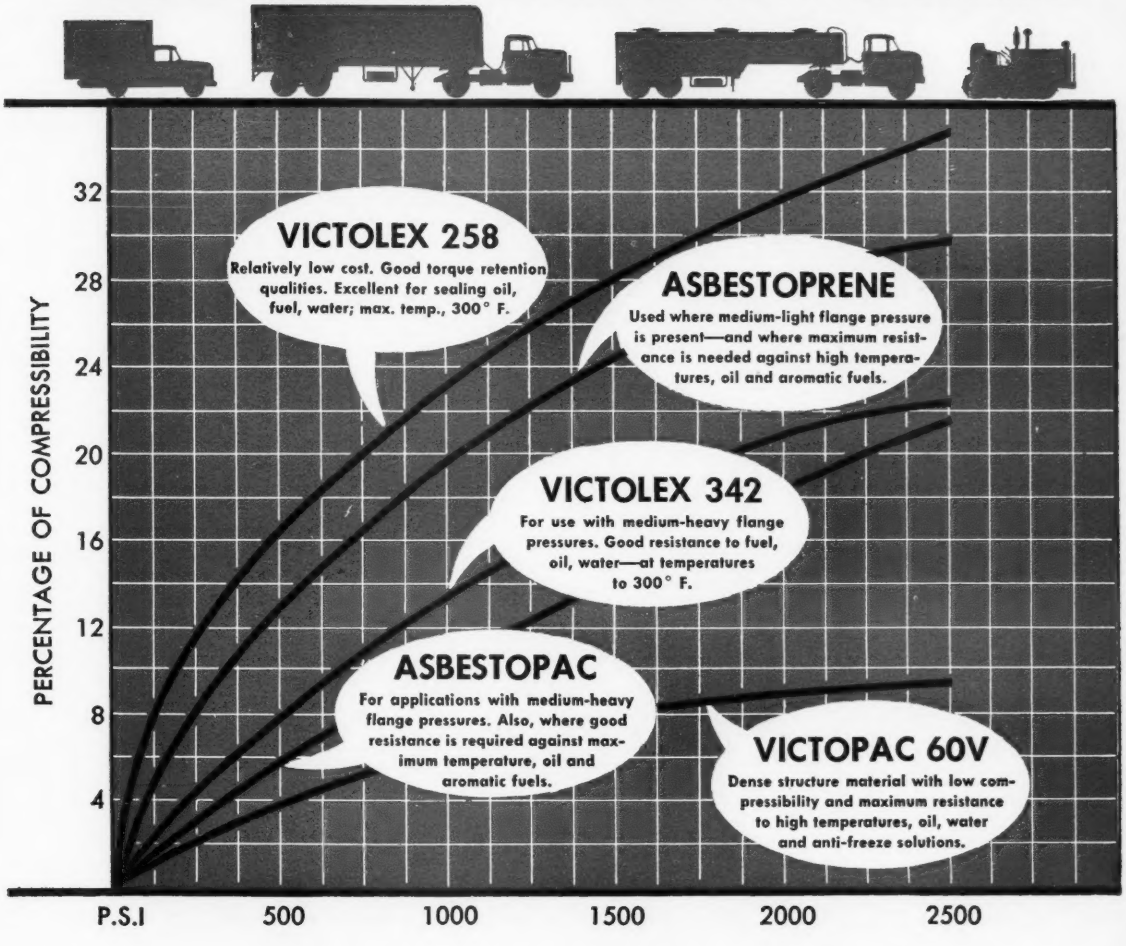
PERCENTAGE OF COMPRESSIBILITY
32
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4
VICTOLEX 258
Relatively low cost. Good torque retention qualities. Excellent for sealing oil, fuel, water; max. temp., 300° F.
ASBESTOPRENE
Used where medium-light flange pressure is present—and where maximum resistance is needed against high temperatures, oil and aromatic fuels.
VICTOLEX 342
For use with medium-heavy flange pressures. Good resistance to fuel, oil, water—at temperatures to 300° F.
ASBESTOPAC
For applications with medium-heavy flange pressures. Also, where good resistance is required against maximum temperature, oil and aromatic fuels.
VICTOPAC 60V
Dense structure material with low compressibility and maximum resistance to high temperatures, oil, water and anti-freeze solutions.
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Full range of synthetic packings

The five Victor "soft" packings plotted on the comparative compressibility chart answer many problems for automotive sealing engineers. Each packing is made of the best materials for coping with problems inherent in specific applications. Each has the right density and degree of compressibility to meet varying flange pressures, temperatures and the penetration of water, oils and other fluids. Each packing conforms to SAE-ASTM specifications.

Complete technical information about these packings and their uses is available from your Victor Field Engineer.

If you do not know where to reach him, write Victor Mfg. & Gasket Co. of Canada Ltd., St. Thomas, Ont. In U.S.—Victor Mfg. & Gasket Co., P. O. Box 1333, Chicago 90, Ill.

VICTOR

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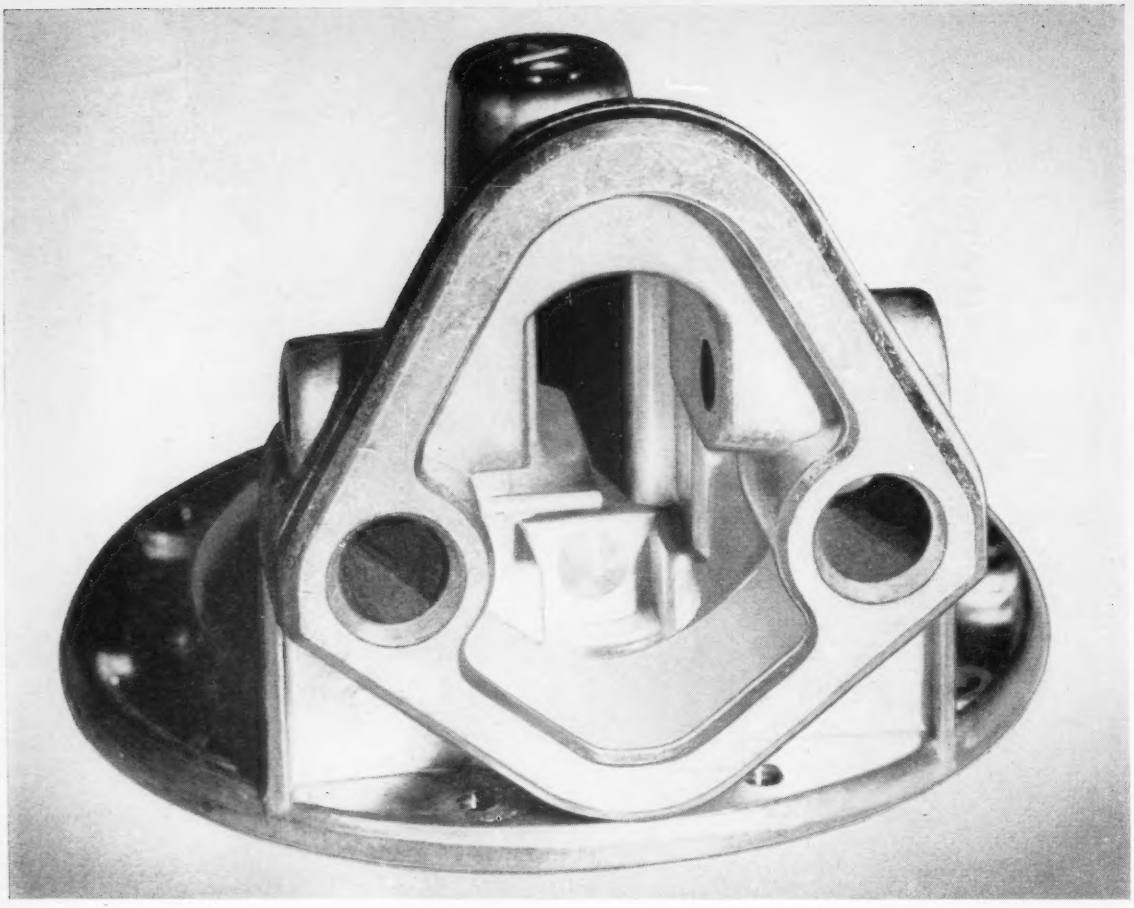

DIE-CAST WITH TADANAC ZINC...

"but what is it?"

The die-casting industry of today is producing more and more complicated shapes, never before thought to be possible. Our illustration is typical of such shapes . . . using Tadanac Zinc of course, because it's ideal for low temperature high speed operation, and has the essential tensile strength and freedom from corrosion.

Tadanac Brand's consistent high purity, its guaranteed supply position backed by one of the world's largest zinc producers and a prompt delivery service, make it a preferred brand by die casters.

If you require any information or assistance regarding your Zinc die-casting operations, write to our Metal Sales Division, where your inquiries will be promptly attended to by our Technical Sales Service Department.

The photo shows part of an Automobile Fuel Pump Casing

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57145-T

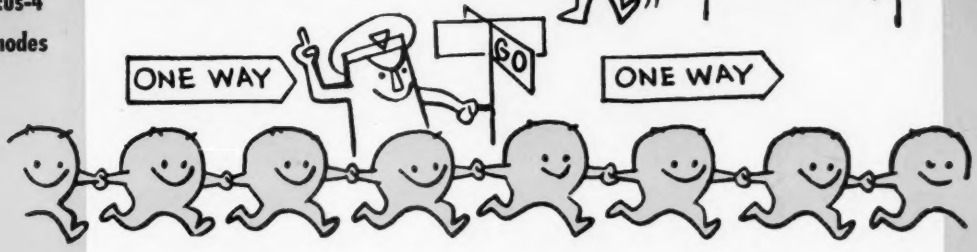
TADANAC ZINC SHAPES THE THINGS TO COME

Anaconda Plus-4 Anodes

Phosphorus policemen arrest delinquent copper ions that want to play instead of work in the solution—thus preventing COPPER BUILD-UP and cutting cost of correcting solution.

Phosphorus policemen wake up lazy copper ions that want to settle down as SLUDGE in the bottom of the tank—thus making "bagging" and diaphragms unnecessary.

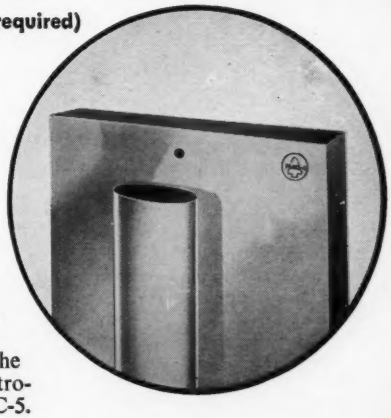
Your Work



Phosphorus traffic police keep copper moving uniformly to give you SMOOTH, HEAVY CATHODE DEPOSIT—up to 15% more cathode deposit per anode—and UNIFORM ANODE CORROSION leaving small "fish" that cut scrap losses.

PLATING COSTS LESS WITH ANACONDA "PLUS-4" ANODES

+1 no anode sludge (no "bagging" or diaphragms required)
+2 no copper "build-up" in solution
+3 smooth, heavy cathode deposits
+4 up to 15% more cathode deposit per anode



The playful characters above give perhaps an oversimplified explanation of a laboratory development now saving acid-copper electroplaters, electrotypers and electroformers a lot of time and money.

Metallurgists have found that if copper used as anodes contains a small but precisely controlled percentage of phosphorus, all the copper moves uniformly through the acid-copper solution to the object being plated. The phosphorus seems to act like a policeman.

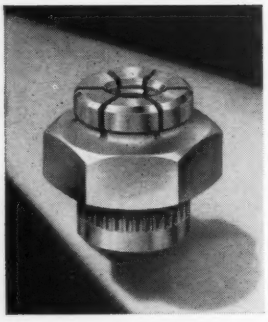
Anaconda "Plus-4" Phosphorized Copper Anodes are the result. They have been proving their superiority in acid electroplating tanks in many parts of Canada. Write for publication C-5.

ANACONDA*

*Trade Mark Reg'd.

ANACONDA AMERICAN BRASS LIMITED
New Toronto, Ontario.
Sales Offices: Montreal and Vancouver

How FLEXLOC clinch nuts save production time



If you are building assemblies of thin-section materials, you can make secure bolted connections with FLEXLOC clinch nuts. Use them instead of cage nuts, anchor nuts and weld nuts. They are easy to install—no riveting or welding is required.

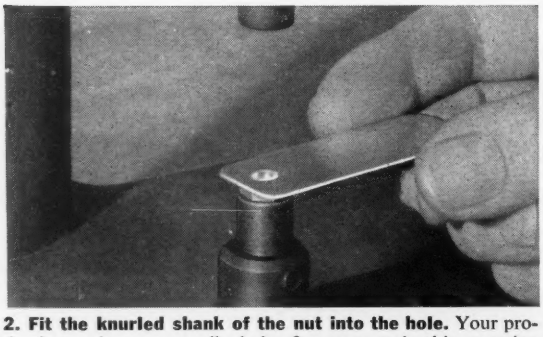
When you design with 1-piece, all-metal FLEXLOC clinch nuts, you simplify production operations by eliminating complicated nut-and-lockwasher assemblies. And the nuts cannot fall off or get lost during maintenance operations.

When you thread in a screw, the FLEXLOC locks it wherever wrenching stops (as soon as 1½ screw threads or more project through the locking section). Locking action is positive and dependable. No matter how many times your product must be reassembled during maintenance or repair, the FLEXLOC holds securely every time. Its locking life is virtually unlimited. It cannot be loosened by vibration.

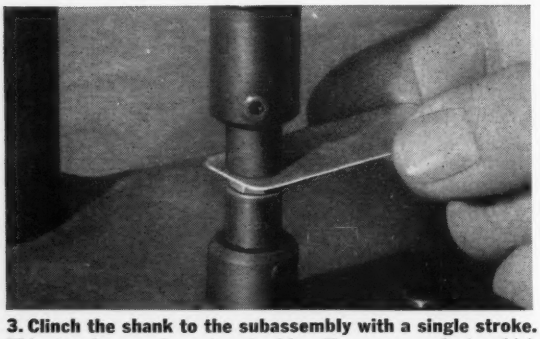
Standard FLEXLOC self-locking clinch nuts come in sizes #0 through ¼ in., for use in materials from 1/32 to 3/16 in. thick. They are made in alloy steel, stainless steel, brass and aluminum. FLEXLOC clinch nuts and clinching tools are available through your authorized industrial distributor. Call him today. Write us for complete specifications, or for information about your special locknut problem. STANDCO CANADA, LTD., 193 Bartley Drive, Toronto 16, Ontario.

It's easy to install a FLEXLOC clinch nut

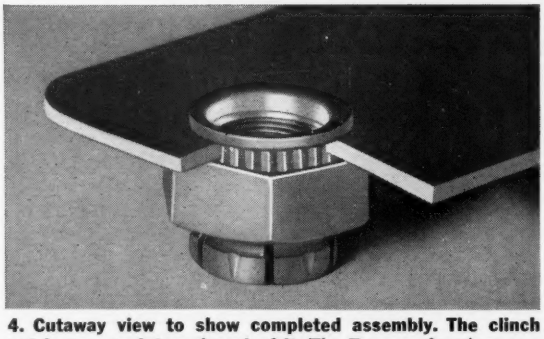
1. Hole in your subassembly accommodates the knurled shank of the FLEXLOC. The holding fixture is fitted with an inexpensive FLEXLOC dolly tip.



2. Fit the knurled shank of the nut into the hole. Your production engineers can easily design fixtures to make this operation completely automatic.



3. Clinch the shank to the subassembly with a single stroke. This electric press is equipped with a FLEXLOC punch tip which also can be used with an ordinary hammer.



4. Cutaway view to show completed assembly. The clinch nut is now an integral part of it. The FLEXLOC functions as a tapped hole—one that will lock a screw securely in place.

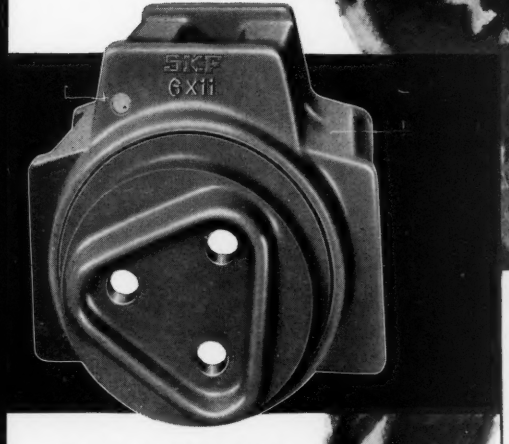
FLEXLOC locknuts are sold through authorized industrial distributors

FLEXLOC®

STANDCO CANADA, LTD.

193 Bartley Drive

Toronto 16, Ontario



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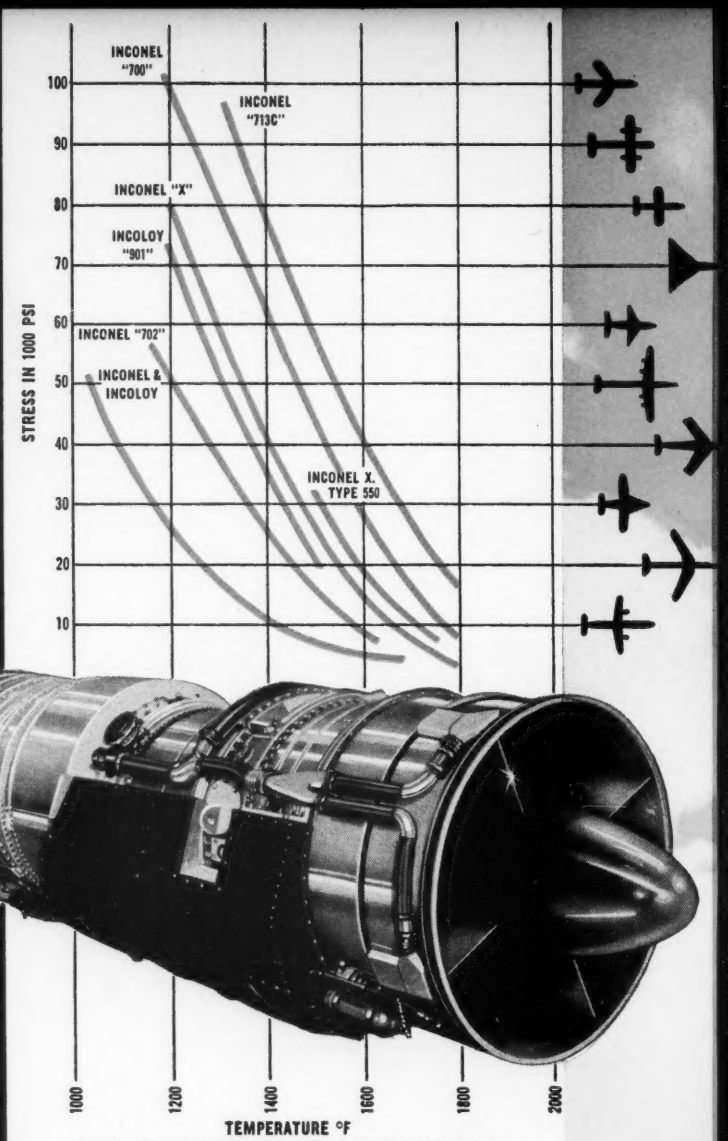
new Inco alloys

give excellent performance in high stress, high temperature aeronautical applications



100 HR CREEP RUPTURE STRENGTH OF SOME INCO ALLOYS

Aircraft engineers will recognize this gas turbine engine... the new Orenda "Iroquois". Some of the Inco alloys employed in the "Iroquois" are depicted on the graph above. This graph shows maximum temperatures which these and other Inco alloys will withstand for 100-hour life at various stresses.

Naturally, the selection of materials for high temperature applications involves many other factors not illustrated in this graph. Where stress is low, for example, higher temperatures may be permissible. Much of this technical information has already been accumulated by Inco.

New wrought alloys such as *Inconel 700 and *Incoloy 901, developed by Inco, are available for high temperature service. A precision casting alloy—*Inconel 713C—has recently been added to the group. Alloys that resist oxidation at temperatures up to and beyond 2000°F. have been perfected.

Modern high speed flight has cleared the sound barrier and is penetrating the thermal thicket. Advanced turbo-jets, rockets and ramjets are producing unbelievable levels of power. As power and speed increase, temperatures become more critical. Inco's research and production facilities are dedicated to the task of keeping abreast of these developments.

For information concerning special Inco alloys for high temperature applications, write today.

*Trade Marks

INCO
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THE INTERNATIONAL NICKEL COMPANY OF CANADA, LIMITED

25 KING STREET WEST, TORONTO

TAKE A CLOSE LOOK AT THE FULL LINE OF RCI

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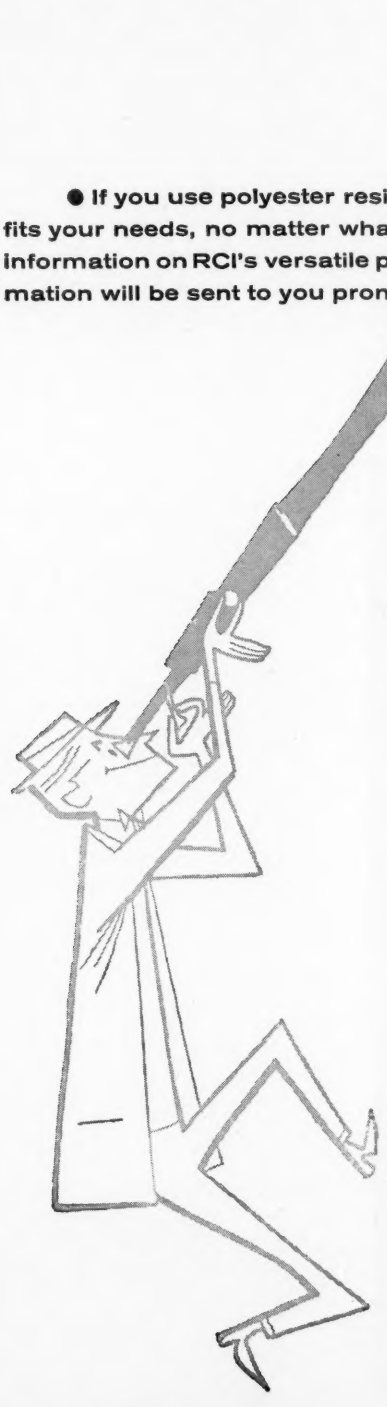
POLYESTER RESINS

● If you use polyester resins, you will find in the RCI line a POLYLITE formulation that fits your needs, no matter what your end product or manufacturing procedure ● For full information on RCI's versatile polyesters, clip and mail the check list below. Technical information will be sent to you promptly.



My Name is_____

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of the company indicated on this letterhead.

Please send me full technical information on the use of RCI POLYLITE Polyester Resins for:

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Creative Chemistry... Your Partner in Progress

RCI

RX *MIXED-FLOW BLOWER UNIT: A TORRINGTON 1st*

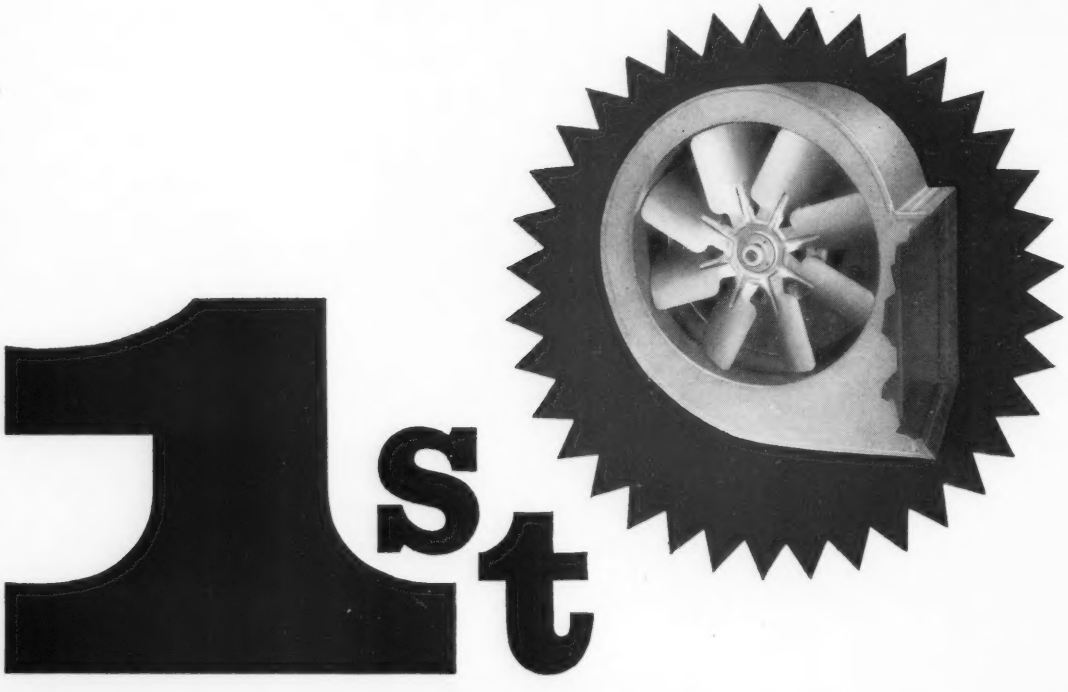
The Torrington RX Radiax blower introduces a new development in air impeller engineering.

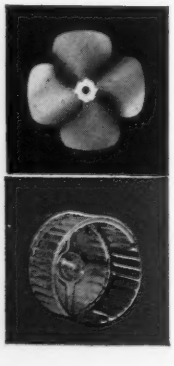
It is a direct drive mixed-flow unit employing an exclusive Torrington design concept which results in the conversion of axially-developed air pressure into a radial flow pattern.

The result of this design breakthrough is a versatile unit that can be tailored to an extended range of customer needs by modification of the axial fan configuration to exact performance specifications. This eliminates dependence upon a variety of different sized units for varying requirements.

The RX offers three important advantages:

PERFORMANCE—A flat power curve makes it a non-overloading unit, permitting the use of a single smaller-capacity motor for varying applications, and availability of the unit in sizes heretofore too large for direct drive applications.





CONSTRUCTION—A vertical center panel divides the unit longitudinally and supports the motor at its center of gravity. Resilient motor and fan mountings minimize noise and vibration. Result is quiet performance, and easy assembly and service.

ECONOMY—The basic design permits size reductions of as much as 36 per cent in the cubic dimensions of the unit, without sacrifice of performance. Thus, the RX is a thinner, more compact unit that can be fitted into tighter areas without choking of air intakes.

The design and performance of the RX give it a versatility that is of special importance to design engineers of air moving equipment. Full specifications are available.

THE TORRINGTON MANUFACTURING COMPANY
OF CANADA LIMITED
OAKVILLE, ONTARIO • TORRINGTON, CONNECTICUT • VAN NUYS: CALIFORNIA

People

Important people who are in the news

Feather in a Canadian cap was being worn recently by **A. M. Cameron** of Atlas Steels in Welland. Cameron was named winner of the Kelly First Award for 1956 at the 50th annual banquet of the Association of American Iron and Steel Engineers in Pittsburg. The award is presented annually to the author of the paper judged to be of the greatest value to the advancement of engineering and operating practice in the iron and steel industry. Mr. Cameron is the first Canadian to receive this award. Title of the prize-winning paper: "Basic formulas for roll design and rolling of alloy steels."

• • •

News at Atlas, too, is the election of **C. D. Howe** to the board of directors. Mr. Howe was formerly Canada's Minister of Trade and Commerce.

RUSSELL BONNER

The Hon. R. W. Bonner, QC, MLA, Attorney-General and Minister of Industrial Development, Trade and Commerce for British Columbia recently visited the Design Centre in England. The shot atop this item shows him discussing a kettle with **Sir Gordon Russell,** director of the Council of Industrial Design, which runs the centre.

• • •

As a result of the recent appointments of **F. Harry Keast** as chief engineer and **Burt Avery** and **Dr. Alex Muraszew** as deputy chief engineers, other changes have been announced in Orenda's engineering department.

George Best, formerly chief performance engineer, has been appointed technical assistant to the chief engineer. Mr. Best has the assistance of **Bob Thomson** as preliminary performance analyst, **Ken Jay** as preliminary design analyst and **Clare Eatock** as preliminary aerodynamics analyst.

Joe Purvis, formerly chief turbine design engineer, was named chief design engineer reporting to Burt Avery.

• • •

New president of Standard-Modern Tool Co. Ltd. and chairman of the boards of A. R. Williams Machinery Co. Ltd., A. R. Williams Machinery Western Ltd. and Pacific Tractor & Equipment Ltd. is **John Gilchrist.**

Gilchrist was managing director of Ex-Cell-O Corp. of Canada Ltd. A native of Scotland, he's an electrical engineering graduate of the University of New Brunswick and a member of APEO and EIC.

• • •

A November appointment announcement from CGE brings to **R. N. Fournier** the title of general manager of the Wholesale Department. Rod Fournier, Saskatoon-born, is a graduate in engineering physics of the University of Saskatchewan and will have his headquarters at CGE's head office in Toronto. Fournier succeeds **Walter G. Ward** who has become general manager of the apparatus department at CGE. Mr. Ward is a 42-year-old professional engineer who joined the company on production work in 1931.

• • •

Two Sun Oil appointments go to John **A. Mustard** and **James C. Dunlop.** Mustard becomes the company's industrial products department representative in Ontario; Dunlop takes the same title for the **Montreal district.**

Mr. Mustard graduated in electrical engineering at the University of Toronto in 1951. Mr. Dunlop is a Queen's University grad in mechanical engineering and, before this appointment, worked in the Montreal area in purchasing and sales capacities in the chemical and equipment industries.

• • •

Gordon E. Marshall, B.A.Sc., P.Eng., is now sales manager for Canadian Chromalox Co. Ltd. A former CGE man, Marshall will supervise the industrial sales and advertising programs of Chromalox. He is a graduate in electrical engineering from the University of Toronto.

• • •

Atlas Powder Co. Canada Ltd. has appointed **E. P. Newman** as its technical sales and service representative. Mr. Newman, who has been technical representative handling the Atlas general line of emulsifiers, polyols and activated carbons, now adds Thermaflow molding compounds to the list of products he represents.

• • •

Thomas J. Bell was elected president of the Canadian Electrical Manufacturers Association at the group's annual meeting in Niagara Falls.

President of Fiberglas Canada Ltd., he will be responsible for guiding the destiny of an association which represents Canada's $1,215,800,000 electrical manufacturing industry.

Born at Southampton, Ontario in 1914, Tommy Bell received his preliminary education at Ridley College. In 1936 he graduated from the University of Toronto with a B. Comm.

These men co-ordinated the engineering effort which went into creating the Arrow—R. N. Lindley, chief engineer; J. C. Floyd, vice-president engineering; Guest Hake, project designer and Jim Chamberlin, chief of technical design.

how satincoat adds lasting beauty and efficiency to the new LORD SIMCOE kitchens

Clean, crisp efficiency today and in the years ahead was a vital factor in building the kitchen installations for this magnificent new hotel.

Here's why Dofasco Satincoat was the logical choice. Part of the reason is on the surface. Because Satincoat is *made* to be painted, paint goes on smoothly without priming . . . and *stays on* to minimize scaling, peeling and the need for repainting.

If you look a little deeper, you'll discover that Dofasco's "Continuous Galvanizing Process" bonds the protective coating to the steel—hammer it, bend it, shape it—the galvanized coating remains intact! Corrosion can't get a start!

For more facts on versatile Satincoat, call your nearby Steel Warehouse, or write direct to Dofasco.

DOMINION FOUNDRIES AND STEEL, LIMITED

HAMILTON, CANADA

23-5265

Dominion Metalwares Ltd. of Port Credit, Ontario, used Satincoat in fabricating the sturdy, wear-resisting kitchen cupboards of the new Lord Simcoe Hotel.

satincoat by Dofasco

High strength without heat treatment

This well-proved aluminum alloy can claim exceptional strength and some unusual ageing features

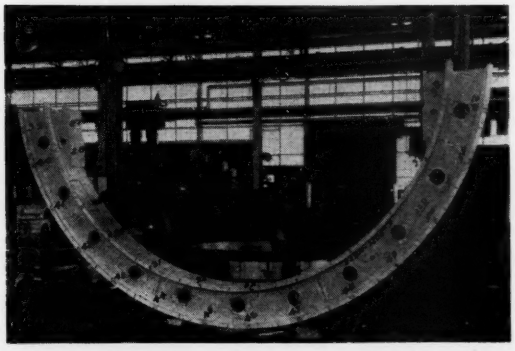
Frontier 40-E is an aluminum alloy having as alloying elements zinc, magnesium, chromium and titanium. It was specially developed to produce high strength aluminum castings not requiring the usual heat treatment to attain the desired physical properties. Its exceptional strength, light weight and ease of processing suggest many applications which formerly were filled by the use of iron, steel or bronze, metals which required considerably more time and expense to fabricate.

Specifications:

ASTM	B26-52T Alloy ZG61a
Navy	46A1 Class 1
Federal, Army & Navy	QQA 601a Comp 17
SAE	310

A British alloy (DTD 5008) was recently issued to cover the use of 40E for aircraft components.

No heat treatment. The alloy ages at room temperature, acquiring physical properties comparable to heat treated alloys. (Artificial ageing at low temperature accelerates this action). This unusual ageing feature means increased strength, relief of casting strains and stabilization without the danger of cracks and other distortions due to quenching.

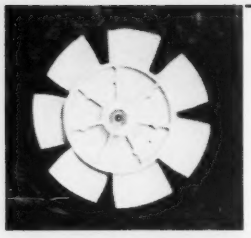


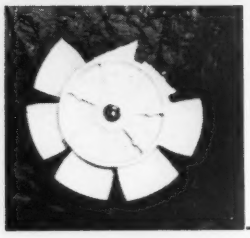
9 ft dia. sand casting held dimensions to within ⅛ in.

40E alloy casting for a canning machine. The alloy's corrosion-resistance suits such an application well.

Shock resistance. Proved during the last war by its use in top gun turrets of Flying Fortresses, the material has exceptional ability to withstand shock, even that due to explosive impact. It resists rupture to a high degree, as well as deformation which, in many instances, can lead to misalignment and consequent uselessness of the affected part.

Corrosion resistance. Not only does it show marked corrosion-resistance under normal conditions: it is also practically stress-corrosion proof in the presence of corrosive liquids and atmospheres where aluminum alloys are used. This feature is of special importance in many chemical and marine applications where durability is required.





Results from drop ball tests made on fan blades using 4% copper alloy, T-6 condition, 5-7% silicon alloy, T-6 condition and 40-E alloy showed that the blade of the fan shattered on the heat-treated alloys while the blade from 40-E did not.

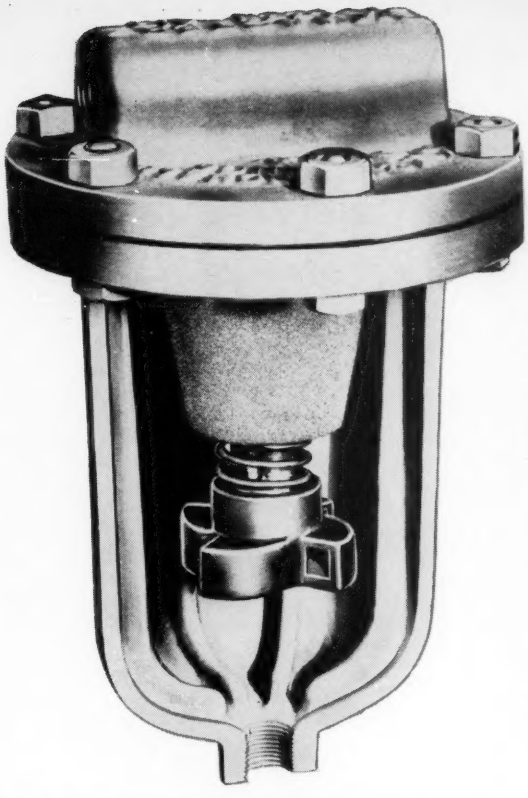
High Yield strength. Often overlooked in the judging of a metal on the basis of tensile strength and elongation only, yield strength (the ability to resist distortion under stress) is of significant value. Frontier 40-E has truly exceptional yield strength characteristics, even though aged at room temperature for a brief period.

Machineability. The material machines freely and the machined surfaces have a smooth, lustrous finish without pitting or tearing due to tool drag. They lend themselves readily to uniform anodization, unmarred by streaking.

Pressure tightness. The fine grain structure of 40-E is a major factor in its resistance to hydrostatic pressure. Extensive tests have shown it to withstand pressures up to 400 psi in castings with wall thicknesses of from ½ in. to 1 in.. Yet this pressure tightness is obtained without sacrificing other desirable physical properties.

Comparison of physical properties of high strength aluminum alloys

	40-E	195-T6	356-T6	356-T51
Composition				
Zn	4.75-5.75			
Mg	.40- .60		.30	.30
Cr	.40- .60			
Ti	.15- .25			
Fe	1.0 max			
Cu	.40 max	4.5		
Si	.30 max		7.0	7.0
Mn	.30 max			
Al	Remainder	Remainder	Remainder	Remainder
Typical physical properties				
Ultimate (psi)	35,000	36,000	33,000	25,000
Yield (psi) (2% offset)	25,000	24,000	24,000	17,000
Elongation (% on 2 in.)	5.0	5.0	4.0	2.0
Compression Yield (psi) (set = 0.2%)	17,000	25,000	22,000	22,000
Brinell (500 kg: 10 mm)	75	75	70	60
Shear strength (psi)	26,000	30,000	27,000	18,000
Fatigue endurance limit (psi)	9,000	6,000	8,000	7,500
Density (lb/cu. in.)	.10	.10	.095	.095
Modulus of Elasticity	10.3×10^6	10.3×10^6	10.3×10^6	10.3×10^6
Linear coefficient of thermal expansion	.0000137	.0000127	.0000119	
Electrical conductivity (% Cu standard)	25	37	39	43
Typical tensile properties at elevated temp.				
(A) (1,000 hr. at 325 F)				
Tensile (psi)	20,000	24,000	21,000	
Yield (psi)	17,000	13,000	16,000	
Elongation (% on 2 in.)	7.0	9.0	5.0	
(B) (1,000 hr. at 400 F)				
Tensile (psi)	13,000	15,000	13,000	
Yield (psi)	11,000	9,000	9,000	
Elongation (% on 2 in.)	10.5	20.0	8.0	
Shock test				
Drop weight (inches deflection)	.12	.19	Broken	
Direct loading (inches deflection)	.25	.28	Broken	



Air flows tangentially through moisture separator. Water is expelled through the drain at the bottom.

Compressed air fights its moisture problems

Water in compressed air is a problem. Here are some answers to the problem

By A. N. Gustafson SCHRAMM INC.

All atmospheric air contains some moisture. The ability of the air to retain vaporized water increases as the temperature is raised, and decreases as it is lowered. In other words, the relative humidity is directly related to temperature. For example, air which has a relative humidity of 80% at 70 F would be only 40% saturated at 90 F.

Pressure has the opposite effect. Air in this respect is like a sponge; the harder you squeeze it, the less water it can hold.

In a compressed air system, air enters the compressor at ambient or atmospheric pressure and temperature. It is then compressed to a higher pressure. This raises the temperature, but the air is never used at the temperature of compression. Heat is dissipated through the cylinder walls, through the air lines and the receiver to the surrounding atmosphere, and (if an aftercooler is used) to the cooling water in it. As the air then travels through the tubing, pipe or hose to the point of use, more heat is lost, and the temperature is reduced further, possibly to room temperature or below.

These changes in temperature and pressure are responsible for the condensation that occurs in any compressed air system, even in dry climates. For example, if free air at 50% relative humidity—rather dry for atmospheric air—were compressed to 100 psi and cooled to room temperature, it would then have a relative humidity of 400%. This is getting foggy. Any further compression or cooling would precipitate water.

The above example deals with extremely dry atmospheric air. Moisture is much more of a problem when the climate is humid. On a hot, muggy summer day, it is not unusual for as much as 2 gal of water to condense in an hour. A typical case will illustrate how so much water can be freed by compression.

Suppose that it is a hot, humid day with a temperature of 90 F and 80% humidity. A compressor is delivering 200 cu ft of air per minute to a sand blast at 80 lb gauge pressure. Each cubic foot of atmospheric air at these conditions contains 0.00175 lb of water. Since 200 cu ft of air are drawn into the compressor each minute, the total water intake in a minute is 0.35 lb. This wet air is then compressed to 80 psi.

Compression heats the air so much that it will carry all the moisture as suspended vapor. The full amount of water is therefore passed through the compressor. This warm air then cools in the receiver and in the air-lines. When it reaches room temperature (90 F) it will be much more than saturated, and about 80% of the moisture will condense. This means that about 0.28 lb of water per minute (1.68 gal per hr) will be deposited in the receiver and the air lines—enough to make the air really wet.

There are several ways to eliminate this water from air lines. In all cases, correct piping and draining will help. Where this alone is not adequate, after-coolers can be employed to condense the water before the air is distributed. And for unusual applications where cooling water is not available (or where air lines must pass outdoors through freezing temperatures), special desic-

cant dryers may be used. The first two methods are used in the majority of installations, so they will be discussed in detail here.

Correct piping and draining will often provide reasonably dry air at the point of use. Even though additional drying methods are used, attention to installation details will help to provide air that is satisfactory.

One of the simplest and most effective ways to decrease air contamination and increase compressor efficiency is to locate the compressor intake carefully. For efficiency, the intake should preferably be outside the building, on the coolest side. Because this cool outside air is more dense than indoor air, a greater quantity of air will be delivered to the compressor. For example, if the outside air temperature averages 40 F and the indoor temperature is 70 F, only 943 cu ft of outdoor air will be needed to deliver the same weight as 1,000 cu ft of indoor air, a direct saving of nearly 6%. The greater the differential between outdoor and indoor temperatures, the greater will be the economy.

Care must be taken, however, to avoid locating the intake near steam or air exhaust vents, which would add moisture to the air. The location should also be free of fine industrial dust or pigments or any other source of contamination. Avoid sulfurous or chlorine-contaminated atmospheres: these substances mix with moisture to produce weak acids, which will attack screens, tools and piping.

If the receiver is of the vertical type, air should enter at the top, so that the moisture can fall directly to the bottom, where it will collect. The outlet from the receiver should be in the shell, near the top. A drain must be installed in the bottom of the receiver and should be opened daily to remove all accumulated water. If automatic drainage is desired, an automatic trap (preferably of the inverted bucket type) can be used. A similar arrangement should be used with horizontal receivers. The entrance should be at the head; the outlet should be in the shell, on the top side near the head. A bottom drain is also required.

Air lines must be large enough to handle demands from machines and services without excessive pressure drop (see Table). These lines should be slightly pitched so that any moisture that condenses will flow in the same direction as the compressed air. At the end of the line (or at a low point in the line) a drop leg should be installed to collect condensate. Either a hand valve or an automatic trap can be used to drain this leg.

Service lines for tools or services should be taken from the top of the main. Although this arrangement usually requires the use of two elbows, it will guarantee that air taken from the main will be dry. Any condensate in the main will flow by on the bottom. Use a check valve wherever there is any chance of liquids backing into the system from other sources, such as in air-purging systems. To remove any remaining water

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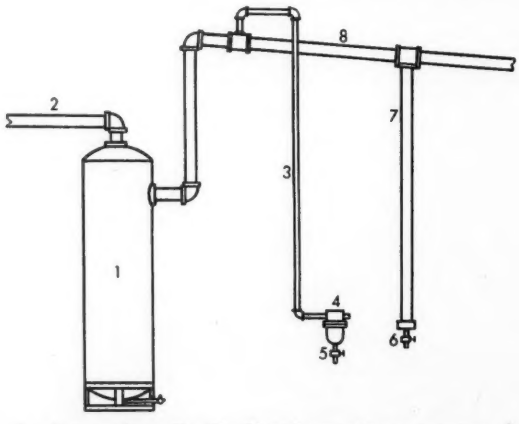


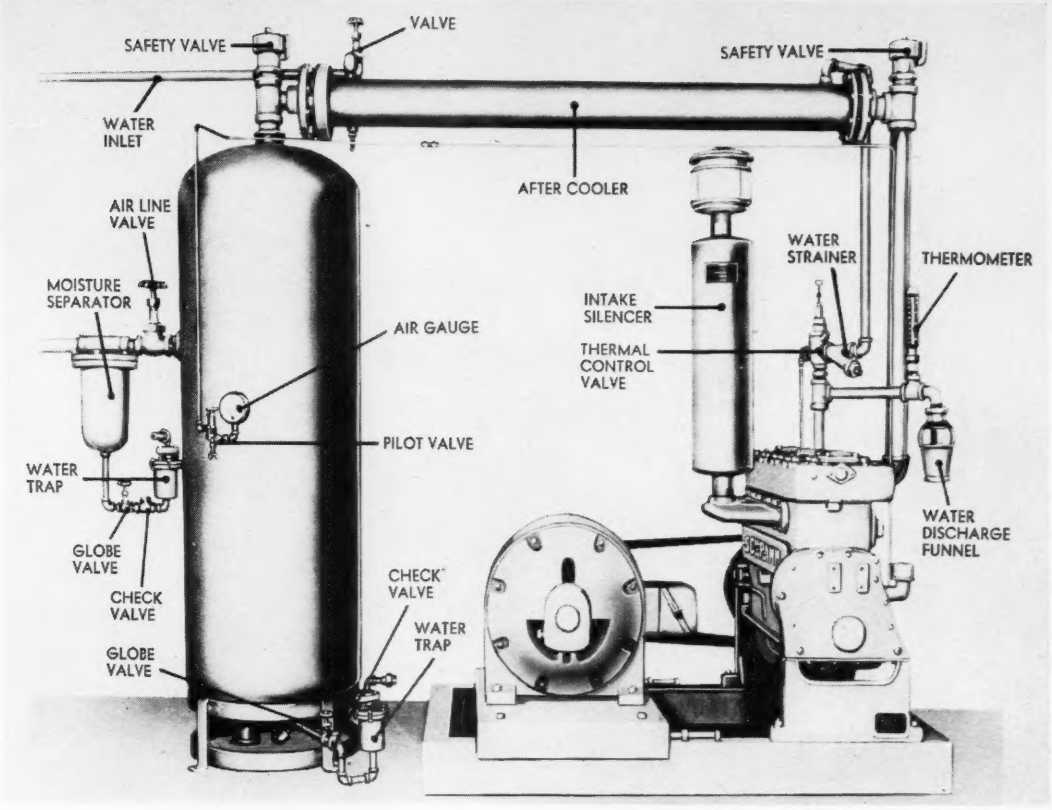
1. Air receiver, 2. Air line from air compressor, 3. Service line from main taken from top of main, 4. A separator close to point of use of air, 5. Drain valve to expel condensate manually from separator. Automatic trap may be substituted, 6. Drain valve to expel condensate manually from drop leg. Automatic trap may be substituted, 7. Drop leg at end of line (or at low point on line) to catch water, 8. Compressed air main pitched in the direction of air flow.

Wet compressed air is an expensive nuisance. It can ruin paint-spray jobs, make sand blasting ineffective by clogging up the sand or corrode piping beyond repair. It can rust air tools and cause excessive wear by washing off the lubricating film from wearing surfaces. It carries dirt and sediment through pipes, and collects in low spots, causing "water hammer," which can loosen scale, rust or dirt into the lines. When exposed to freezing temperatures, it can plug or even burst piping.

How does water get into compressed air lines? How can it be kept out? The answers to these questions become increasingly important as compressed air is used to power a growing number of tools, machines and pneumatic diaphragm valves and controllers. Sand blasting machines, cement guns, soot blowers, material conveyors, sensitive control instruments, liquid atomizers and agitators are all run by air. And new applications are being developed daily.

Practically every company uses compressed air. Chemical, fertilizer, food and petroleum processing plants depend on it for power and instrumentation, as do automotive, aircraft, textile, appliance and ceramic manufacturers. Air is also widely used in papermaking, woodworking, mining and quarrying, shipbuilding and in power generating stations. It is therefore important for the engineer to understand the factors that affect the moisture balance of compressed air, and the techniques for eliminating undersirable water from air lines.

By knowing the characteristics of compressed air, and by properly applying the drying techniques discussed here, it should be possible to eliminate costly water from practically any compressed air system. Paint jobs will be improved, sand blasting will be more efficient and the life of tools and piping lengthened.



Table

Pipe diameter (in) required to pass a given amount of air at 100 lb gauge pressure with less than 1 lb drop in pressure

Free Air per min. cu. ft.	Length of pipe (ft.)										
	50	100	200	300	400	500	750	1000	2000	3000	5000
20	¾	¾	¾	1	1	1	1	1¼	1¼	1¼	1½
40	¾	1	1	1¼	1¼	1¼	1¼	1½	1½	2	2
60	1	1	1¼	1¼	1¼	1½	1½	2	2	2	2½
80	1	1¼	1¼	1½	1½	1½	2	2	2	2½	2½
100	1¼	1¼	1½	1½	2	2	2	2	2½	2½	3
125	1¼	1½	1½	2	2	2	2	2½	2½	3	3
150	1¼	1½	2	2	2	2	2½	2½	3	3	3½
175	1¼	2	2	2	2	2½	2½	2½	3	3	3½
200	1½	2	2	2	2½	2½	2½	3	3	3½	3½
250	1½	2	2	2½	2½	2½	3	3	3½	3½	4
300	2	2	2½	2½	3	3	3	3	3½	4	5
400	2	2½	2½	3	3	3	3½	3½	4	4	5
500	2	2½	3	3	3	3½	3½	4	5	5	5
600	2½	3	3	3½	3½	3½	4	5	5	5	6
800	2½	3	3½	3½	4	4	5	5	5	6	6
1000	3	3	3½	4	4	5	5	5	6	6	8

Making child's play of unusual terrain the Volkswagen-powered Rat hustles over snow (top) and through water.

Canadian design to out-jeep the jeep

A "go-anywhere" workhorse, the Rat can tackle snow, marsh and water

By Fred Inglis OTTAWA CORRESPONDENT

Described as the greatest development since the "jeep," a new type of vehicle (designed by the Canadian Army and Canadair Limited) was given a press preview at the army's vehicle proving grounds near Ottawa recently.

The product of five years of study, research and construction, the new light tracked vehicle (primarily designed for use by troops in the Far North) promises to revolutionize cross-country travel for the armed forces. Trappers, foresters, construction crews, surveyors and even wealthy hunters and fishermen may eventually find it answers their transportation problems.

Known as the "carrier, cargo, light, articulated," army men have given it a more easily handled name "the Rat."

Built in two sections, linked together, the vehicle is powered by a small 4-cylinder gasoline engine located in the front unit, with a power take-off driving 48-in. wide treads under both units. The second half can carry a cargo of 600 lb and the rear carrier hauls another 1,500 lb behind it on toboggans.

Both sections are tracked. Steering is performed by bending the vehicle in the middle by a system of steel cables attached to a steering column.

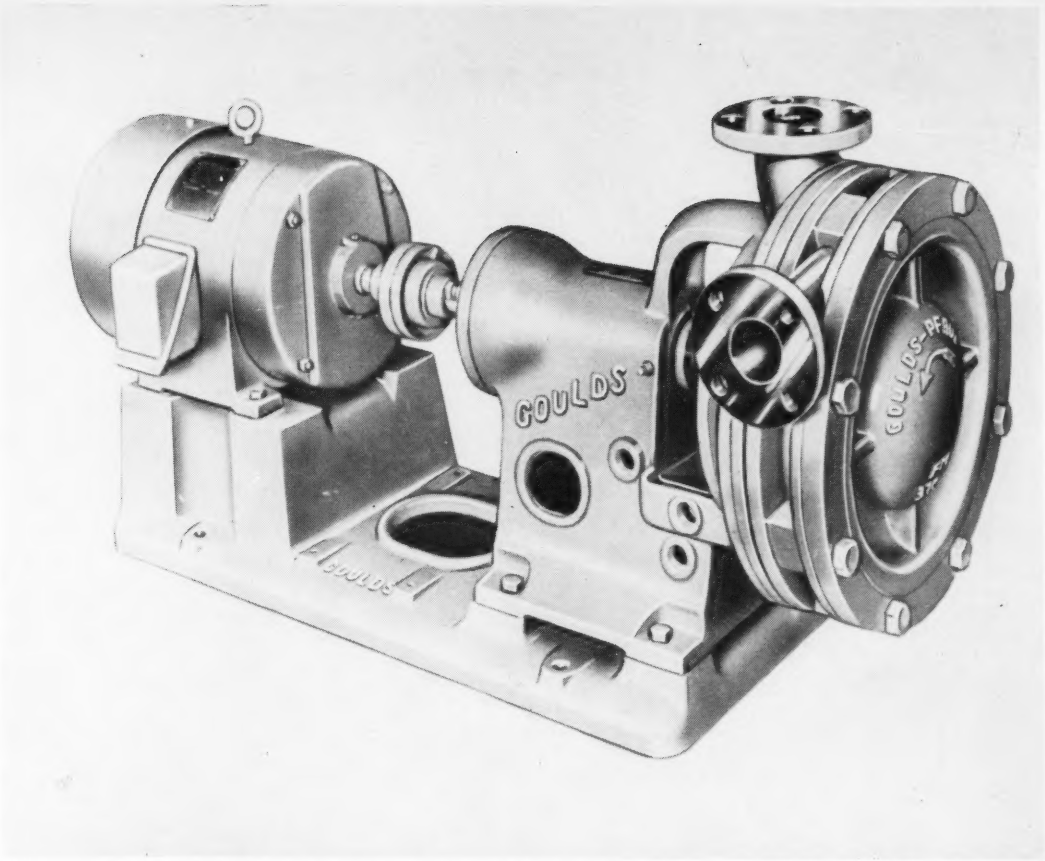
The Rat can run in an 18-ft circle, climb snow-covered slopes when 60% fully loaded and operate at speeds from 2 to 22 mph. It has four forward speeds and one reverse. It needs no brakes as friction holds it static, even on steep inclines.

It is designed to carry the ammunition and equipment of a fighting platoon (in training or in battle) at a walking speed of about 4 mph.

, The Rat weighs only 1,500 lb and exerts a ground pressure of less than 0.5 psi. Motors used in the six early models are standard Volkswagen engines, with a modified transmission and gear box.

Over-all length is 154 in; over-all width, 48 in; over-all height to top of windshield, 59 in. It has a low silhouette and with a low c.g. maintains good stability.

Army officers say RCMP and Northern Affairs officials have shown keen interest in it. ★



This corrosion-resistant pump is available in four sizes for capacities up to 700 gpm and heads up to 140 ft.

Glass lets the pump handle corrosives

Combining glass and metal in an efficient pump needed a canny design

Allen B. Lohr GOULDS PUMPS INC.

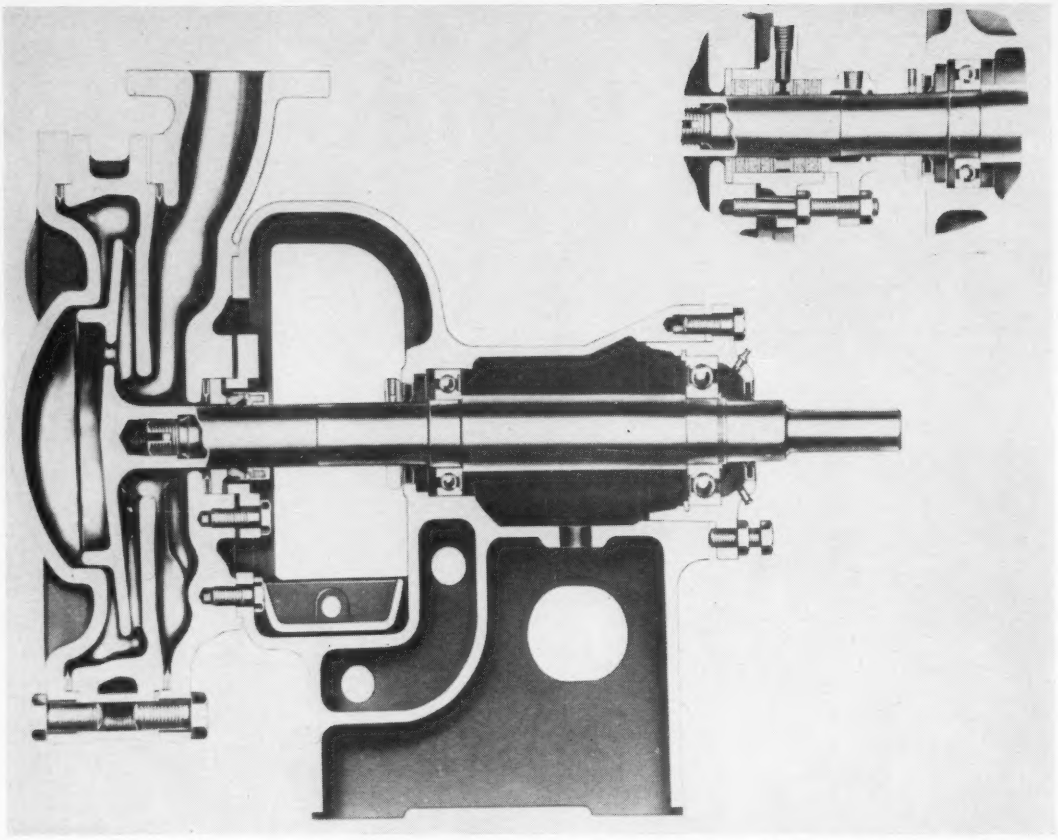
The chemical processing industry (and other industries that handle corrosives) have long been faced with the problem of finding a pump rugged enough to handle their products and still do a pumping job. Heretofore, much concentration of corrosion engineering has been on reactors, storage tanks, valves, piping and other types of process equipment. When it came to pumps, two courses of action were possible: the first was to switch pumps (or pump parts) whenever there was a change in the corrosive nature of the product being handled; the second was to engineer a corrosion allowance into the pump to prevent it from wearing too fast.

Both methods were costly and inefficient. In some cases, process industries considered pump life in terms of a week. Large inventories of pumps and pump parts were essential. Where higher alloys were involved for corrosion service (such as those containing nickel, chrome, moybdenum or copper) a tremendous investment was required. Such methods of stocking became too expensive, even for pump manufacturers who needed wide distribution to provide quick service.

The solution to this problem depended upon the use of a universally corrosion-resistant material in a hydraulically efficient pump. Two leading manufacturers in their fields, Goulds Pumps, Inc., Seneca Falls, N.Y., (makers of centrifugal pumps for industry) and The Pfaudler Co., Rochester, N.Y., (producers of glassed steel and alloy corrosion-resistant process equipment) combined their special skills to develop a pump that would meet pumping standards of process industries and fulfill corrosion resistance requirements. The result of this co-operative effort has been a glassed metal centrifugal pump which has proved itself in extensive field trials.

To produce such a pump, several technical problems had to be overcome. Pfaudler performed the

The pumping of corrosives has been a prime headache in the chemical and process industries. The solution is the glassed pump.



Cutaway internal view of glassed metal pump. Suction here is vertical but may be varied 90 deg on either side.

operation of glassing the statically and hydraulically balanced impeller on both sides. Generally, in tanks, reactors or pipe, glassed metals only need the glass be applied to one side (or surface) of the metal. In addition, it was necessary to devise techniques for machining certain glassed metal parts (such as impeller shafts) to precise limits.

Glassed metal was a new material for pump construction and required application of the best pump design techniques by Goulds engineers. To produce an efficient pump, a design was necessary that would make the best use of accepted hydraulic techniques and still provide the strongest possible construction for glassed metal. Sharp corners also had to be removed. Goulds and Pfaudler designers had to keep glass in mind every step of the way. To permit glassing the insides of the pump chamber and associated parts, a special three-piece construction was developed. The casing, suction piece and casing cover are separate glassed parts which fit together to make a corrosion-resistant pumping unit.

To show how successful was the integrated work of many different departments of both companies in producing the new pump, it is necesary to appraise both the pump design and its corrosion resistance. All inner surfaces of the pump are glassed so that the liquid being pumped never comes into contact with metal. Thus, the full corrosion resistance of Pfaudler's glass to all organic and inorganic acids (except hydrofluoric) and alkalis up to pH 12 at 212 F are fully utilized. This means that the processor can switch from one product to another without worrying about the corrosion resistance of the pump. It cuts down changeover time and eliminates the need for stocking different pumps and different pump parts to handle specific products.

In addition to overcoming corrosion problems, the glassed metal pump has a number of outstanding hydraulic advantages. Flow qualities are improved. Glass also eliminates adherence of the product being pumped to the interior of the pump. Many polymers (particularly plastics and synthetic rubber) cling to metal surfaces but will not stick to glass. Glassed metal also facilitates cleaning operations, reducing down time.

Since glass is inert, it exerts no catalytic effect. It will not enter into any side reactions likely to contaminate products. Elimination of possible contamination during pumping stages overcomes a major problem for some processors. Frequently, a very slight amount of metal pickup or contamination can ruin an entire batch or greatly reduce product quality. Since the interior of the pump is glassed, there is no chance of contamination.

Surprising structural strength of the glassed metal

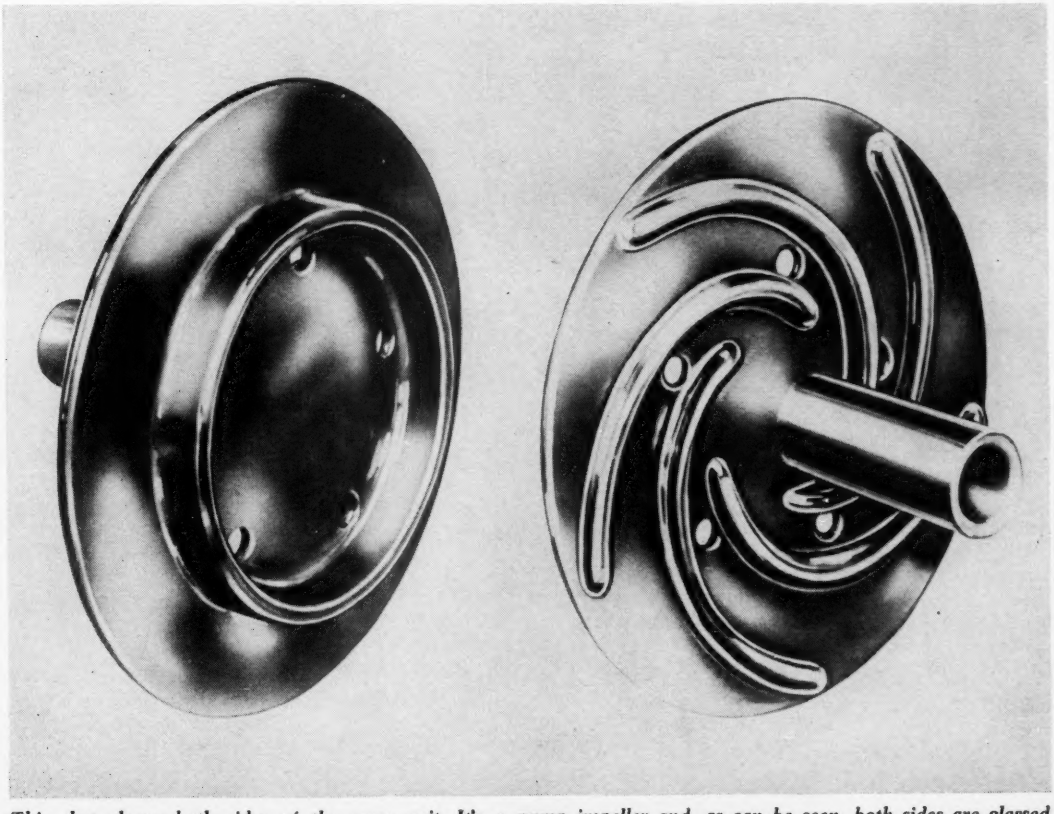
"On top of anti-corrosion properties, there are hydraulic advantages"

results for a number of reasons. Glass and iron become solidly bonded by chemical action at high temperatures in a furnace. Compressive force that build up as the glass cools after firing have a toughening effect. And, of course, the metal itself supplies strong structural support for all parts.

From the standpoint of pump design, Goulds has built a unit for long and dependable service. Three piece construction of the pump facilitates the use of glass on surfaces that come in contact with the liquid being pumped. The casing, suction piece and casing cover are individual parts and may be separated by removing bolts. This three-piece design provides desirable flexibility in pump installation. With a movable suction piece, the processor can place suction in any one of three positions: either a top vertical position, or 90 deg either side of vertical. Naturally, it facilitates mounting with other process equipment already installed. Discharge is also flexible because of this particular arrangement of casing assembly. The discharge outlet can be placed in four different positions. The casing assembly is sealed with retained Teflon envelope gaskets. There are no auxiliary openings to cause localized corrosion or adherence of material being pumped. Thus, a smooth uninterrupted flow is assured.

Placing the stuffing box on the suction side of the impeller is a significant advantage, because the stuffing box is subject only to the suction head or pressure under which the pump operates. Discharge pressure does not work against the stuffing box. This insures long mechanical seal or packing life. Three-piece construction of the casing assembly also permits inspection and maintenance of the pump without breaking the suction or discharge piping connections.

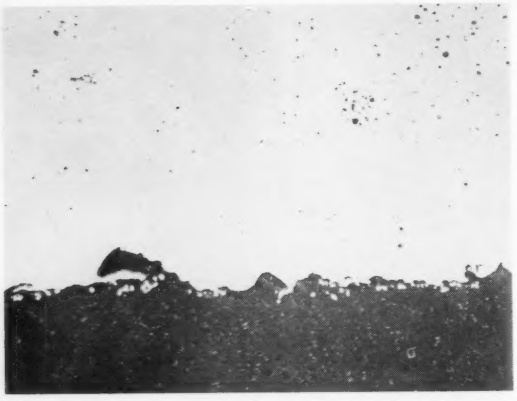
The pump impeller is of the semi-open type, statically and hydraulically balanced. It screws on the shaft with the right-hand threads which tighten against rotation, and is locked in position with a fiber insert. The hub, ground to size, extends out beyond the mechanical seal or stuffing box area and so no internal joints come in contact with the pumpage. Specially designed for glassing, the impeller is glassed on all surfaces in contact with the liquid. Depending upon the size of the pump, the impeller is capable of handling solids ranging up to



This shot shows both sides of the same unit. It's a pump impeller and, as can be seen, both sides are glassed.

5/16 or ¾ in. This ability to handle solids is highly desirable in many industries which must move corrosive slurries.

Increased versatility of the pumps results from the use of either a mechanical seal or a stuffing box. Seal faces are non-metallic and corrosion resistant and can be furnished for a suction pressure up to 150 lb and for temperatures to 350 F for special applications. Split type quench gland seals can also be used. Where a stuffing box is used, units consisting of die-formed Teflon mica-impregnated rings, 1/16 in. Teflon spacer and a Teflon sealed ring can be packed completely with Teflon. A ring of packing prevents any liquid from spraying and traveling along the impeller shaft.

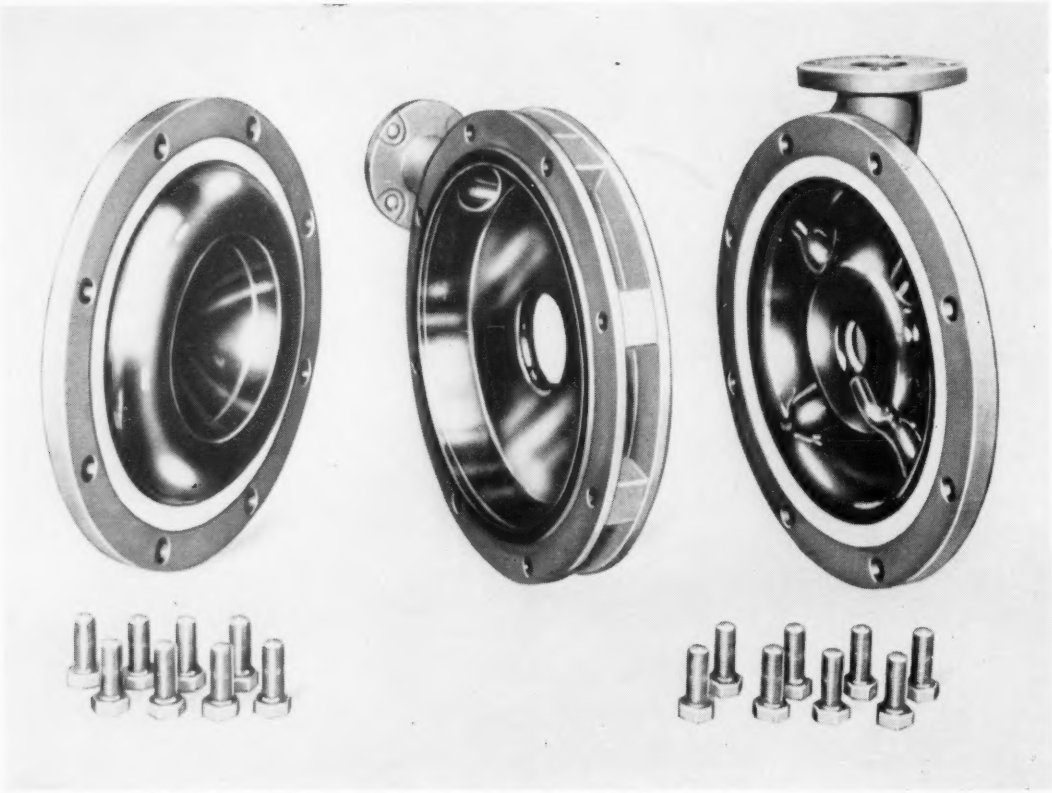


Magnified view of interlocking chemical bond between glass and cast iron created at fusion temperatures.

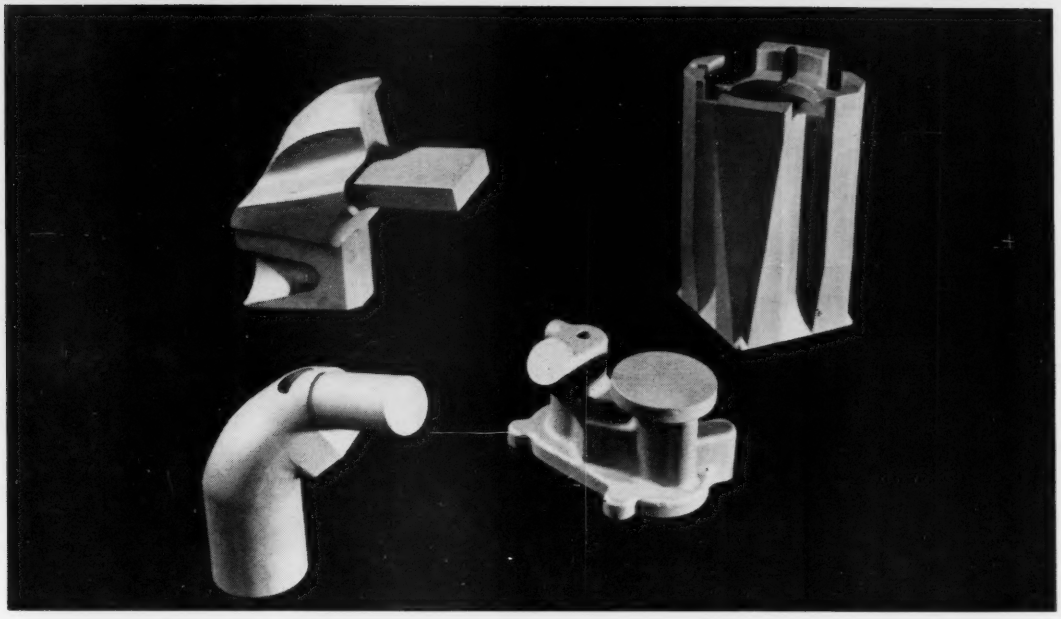
The support head of the pump is designed with wide openings to give ready access to gland and stuffing box, and is an integral part of the bearing housing casting. Cooling chambers are provided to isolate bearings and prevent heat transfer through the pump casing to the bearings. The pump casing is bolted to the support and permanently aligned by means of a male and female lock fit. In addition, a corrosion-resistant drip basin is provided in the support head. Gland drip or leakage can be passed away through tapped openings.

The impeller shaft of the pump rotates on two grease-lubricated ball bearings. The bearing at the coupling end takes a radial and unbalanced thrust load while the inboard on the shaft is free to float axially and take radial load only. Axial adjustment of the rotating elements for proper impeller clearance is obtained by simple but positive external means. The pump is suitable for outdoor installation because it is completely sealed to exclude moisture and dirt, and is ideal for locations where units are hosed down.

The cast-iron bed plate has a specially designed camber for added strength and rigidity. Camber also prevents corrosive liquids from being caught on the bed plate surface; they flow right off. A large beaded lip hole is provided for grouting. All pumps of this series are built with right-hand construction, rotating clockwise when viewed from the driver end. ★



Note the special 3-piece casing assembly . . . suction piece (right), discharge opening (centre), casing (left).



An aluminum casting with a guarantee

For the first time in the history of aluminum investment castings, a casting manufacturer will guarantee the tensile strength, yield strength and elongation actually present in any casting. And these properties are guaranteed to be far higher than are specified for the finest aluminum investment castings, those known as aircraft quality.

This far-reaching development has been announced by Arwood Precision Casting Corporation of New York: the improved castings are the result of entirely new casting techniques.

A comparison with aircraft quality castings shows that, not only does this new "Suparcast" process improve properties throughout the entire casting, but that still greater improvements can be made in critical or high-stress areas.

The degree of improvement over Aeronautical Material Specification 4260 is shown by the tabular comparison. AMS 4260 calls for these properties in specimens cut from the casting. In other words, these were the highest guarantees that any casting user could get.

Now, with its new process, Arwood can guarantee in all areas of the casting the properties shown in the column headed "Suparcast."

In critical areas, these guaranteed properties can be raised to the following:

Tensile strength	38,000 psi
Yield strength	27,000 psi
Elongation	5%

With guaranteed mechanical properties like these, many new uses are foreseen for aluminum investment castings. In fact, the new techniques permit casting of parts that previously could only be made by forging or machining.

Since new highs in strength and ductility are now guaranteed, engineers can design castings to higher limits. They can increase the strength and decrease the weight. In addition, lower porosity means improved pressure tightness.

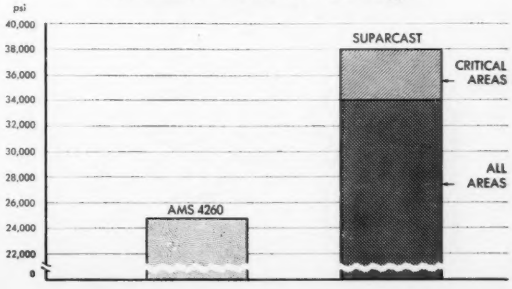
Formerly, aluminum investment castings were limited in aircraft mainly to fittings, or "hardware" applications. The improved properties will now permit designers to use them as load-carrying parts, subject to shock and impact.

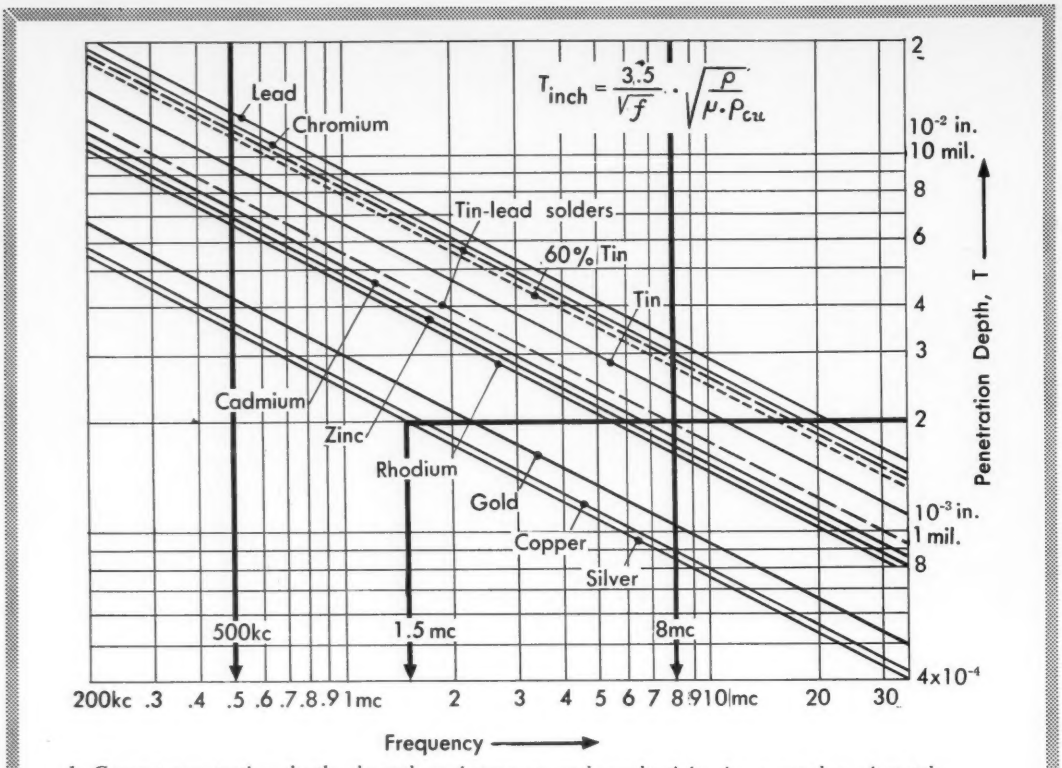
A further point is that the new castings, unlike ordinary castings, are sounder in their thicker sections. Designers who kept away from heavy sections in the past, can now use them without fear of structural weakness. ★

Comparison table

	AMS 4260	Suparcast
Tensile strength (psi)	24,750	34,000
Yield strength (psi)	16,500	25,000
Elongation %	0.7	3%

Ultimate tensile strength





1. Current penetration depths depend on frequency and conductivity for a number of metals.

Eddy currents that tell the thickness

Properly applied, they'll make an accurate and simple thickness test

By Ants Piip BOONTON RADIO CORPORATION

When a conductor is brought into the field of a coil excited by an alternating current, eddy-currents are induced that circulate in closed loops in the conductor. The eddy currents generate an electromagnetic field, which in turn induces an electromotive force in the exciting coil that tends to oppose the original current in it, thereby changing its impedance. The effect on the coil is equivalent to the introduction of an additional "reflected impedance" in the coil circuit.

The amount by which the coil impedance changes depends on a number of factors. These are: the electrical and magnetic properties of the conductor, its configuration, the coil-conductor spacing, the geometry of the coil and the frequency.

The relationships are quite complex, but they all involve a quantity which has been named the "penetration depth." It is the thickness (T) of the surface layer of the conductor which contains practically all the circulating eddy currents. The magnitude of T can be expressed as:

$$T = \frac{3.5}{\sqrt{f}} \sqrt{\frac{1}{\mu} \cdot \frac{\rho}{\rho cu}} \text{ inches}$$

where f = frequency in cycles/second
$\rho/\rho cu$ = ratio of resistivity of conductor to that of copper,
μ = relative permeability of conductor.

T is smaller for materials with high conductivity (low resistivity). Ferromagnetic materials have very small penetration depths.

Fig. 1 illustrates the dependence of current penetration depths on frequency and conductivity for a variety of metals.

The significance of the penetration depth in eddy-current thickness measurement is that films appreciably thicker than T are equivalent to infinitely thick slabs from the standpoint of eddy currents, and any thickness variations of the films can be detected by observing the coil impedance, if the films are thinner than T.

In the case of conductive films on conductive basis materials, it is the penetration depth in the coating material that determines the maximum measurable thickness. Usually, only film thickness up to a fraction of the penetration depth in the coating material can be detected reliably, depending on the ratio of the conductivities of

Available testing methods

The measurement of the thickness of thin coating films is a problem that quite a few branches of industry have to cope with. The methods hitherto available for this purpose all had a number of drawbacks, and the need for a rapid, simple and nondestructive test has been quite urgent, especially in the case of metallic coatings such as electroplated ones. Looking at the more common methods, the reason for this need becomes clear. The usual methods can be grouped as follows:

a) **Mechanical.** Applicable only to specimens of rather simple shape. Involves the measurement of dimensions at the same spot before and after plating.

b) **Optical.** The method is destructive, since it entails mounting, slicing and polishing sample sections of the specimen, and observing the result at a known magnification. It is also time-consuming, and requires a fair amount of equipment and trained operators.

c) **Chemical and electrochemical.** Destructive methods, usually based on stripping a known area of the coating and determining the weight of the removed coating, or, in the case of the electrochemical method, the number of ampere seconds required to deplate a known area of the coating.

d) **X-ray and Betaray methods.** These are usually nondestructive, but need quite elaborate instrumentation and trained personnel, and the evaluation of the results can be rather difficult.

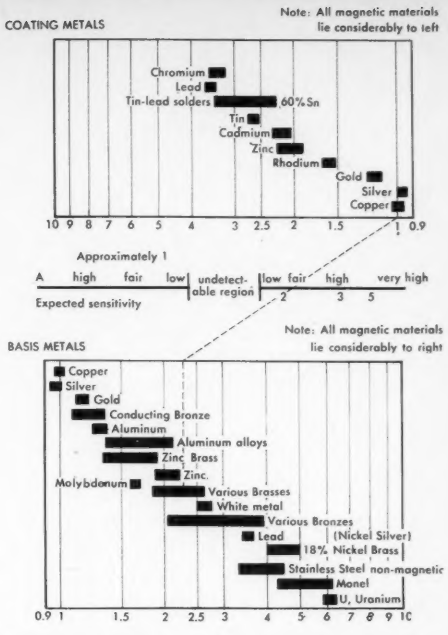
e) **Magnetic methods** are obviously applicable only in cases where at least one component is ferromagnetic.

f) Methods involving the measurement of **electrical conductance** are not very popular, because they always involve rather large and clumsy probes, and require very good contact between the probes and the specimen. In addition they are useless in the case of nonconducting coatings.

g) **Thermoelectric** methods suffer approximately from the same drawbacks as those involving only electrical conductance.

h) Last but not least, **eddy currents** can be used for the measurement of film thickness. If properly applied, they make possible a rapid, nondestructive determination of the film thickness by inexperienced operators, without the need for too elaborate instrumentation. In common with the methods described under (e), (f) and (g), their main usefulness is in the form of comparators, meaning that calibrated standards are required for absolute thickness measurement.

This article shows how eddy currents are used.



2. Frequency parameter A and expected sensitivity as functions of basis and plating materials.

the coating and basis materials.

Since eddy-current phenomena are frequency-dependent, the success of any measurement based on them will to a large degree depend on the correct choice of test frequency.

In the case of conductive films on nonconductors, this is simple indeed. The frequency should be chosen so that the maximum expected film thickness will be about the same as the penetration depth (Fig. 1).

The second case (nonconductive films on a conductive basis) is elementary also. In fact, any frequency will do in this case, and secondary considerations (such as the linearity of the thickness-reading curve) will be the determining factor.

But the case involving conductive films on a conductive basis requires closer attention. As was pointed out, the relationships between the reflected impedance of the probe coil and the composition of the specimen are quite complex, depending on the thickness of the coating and the ratio of the conductivities of the coating and the basis. In principle, a thinner coating requires a higher test frequency. Also, coatings of lower conductivity should be measured at a somewhat higher frequency than those of higher conductivity, but comparable thickness on the same basis metal.

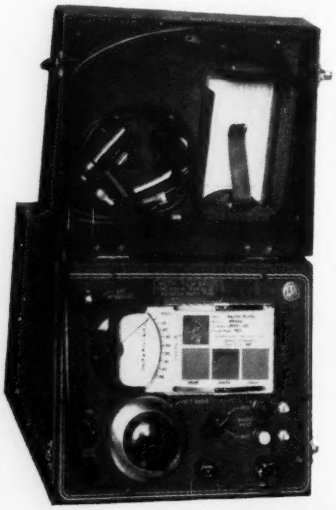
All these factors have been included in the nomograph of Fig. 2. Using Figs. 1 and 2, it is possible to determine the test frequency quite easily for any given coating-basis combination. Information can also be gleaned from Fig. 2 concerning the sensitivity of measurement of the combination in question.

The factor "A" for each combination of the more common coating and basis metals is obtained by dropping perpendiculars from the boxes relating to the coating and basis metals to the appropriate base lines of the nomograph (Fig. 2) and joining these points by a straight line. "A" is then found at the intersection of this straight line with the centre line. This figure represents the ratio between penetration depth in the coating metal and maximum expected coating thickness, in cases where reliable measurements can be obtained.

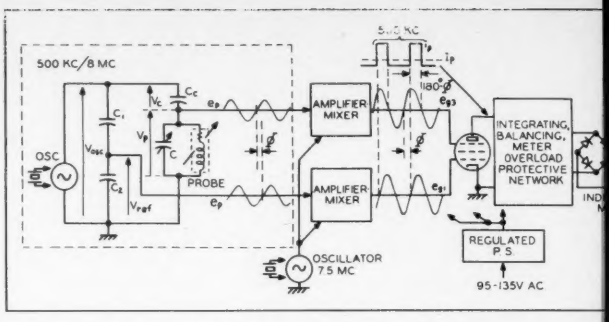
Let us assume that it is desired to measure 1 mil (10^{-3} in.) of silver plating on a yellow brass of average composition. For this combination, we find from Fig. 2 that "A" is approximately 2. Consequently, choose a test frequency so that the penetration depth in silver is about 2 mils. From Fig. 1, this is obtained at a frequency of 1.5 mc. A frequency somewhat lower (such as 500 kc) will increase the maximum measurable thickness, but some loss of sensitivity is to be expected on very thin coatings. A higher test frequency (like 8 mc) will prevent us from measuring up to the full 1 mil thickness, although we get better sensitivity on very thin platings.

Fundamentally, the eddy-current film thickness gauge (BRC Type 255-A) consists of an oscillator driving probe and reference phase circuits. The probe circuit is made resonant at the oscillator frequency, with the probe placed on the basis material. Both the probe signal and the reference signal are impressed (after suitable amplification and amplitude limiting) on the grids of a gated-beam phase detector tube. The plate current of the phase detector varies in accordance with the phase difference between the probe and reference signals, and actuates the indicating meter. The meter has easily interchangeable scales which can give a direct reading on any plating-basis combination and obviate the need for separate calibration curves. Two complete probe assemblies go with the instrument, one for 500 kc and one for 8 mc. The probe coils are of approximately ¼ in. diameter, making possible measurements on flat samples over ½ in. across.

The reason for making the instrument phase-sensitive (rather than amplitude-sensitive) is that phase changes are less affected by slight variations in probe spacing, orientation and reasonable surface imperfections (such as scratches, dirt or scale) than functions which also involve the magnitude of probe impedance. Phase changes are also relatively independent of voltage levels.



3. The control face of the metal film gauge.



4. Functional block diagram of the metal film gauge.

A more thorough understanding of the operation and design of the instrument can be obtained by referring to the functional block diagram (Fig. 4) and the phasor diagram of the probe circuits (Fig. 5).

The sample cards carry a piece of the basis material. Specimens of known film thickness on this basis material, together with the appropriately calibrated meter scale, are inserted in the holder in such a way that the calibration comes against the edge of the transparent meter case, thus making the instrument direct-reading in thickness. The encapsulated probe coil is carried on a spring loaded plunger which keeps the spacing and orientation of the probe coil constant in relationship to the specimen.

Being inherently a comparator, the instrument required standards of known film thickness for each film-basis combination to be measured.

Since both the conductivity and permeability can show considerable variations, depending on the local composition of the material, its heat treatment and previous history (work hardening and so forth) care must be exercised that the calibrated standards really are representative of the materials encountered in the subsequent measuring process.

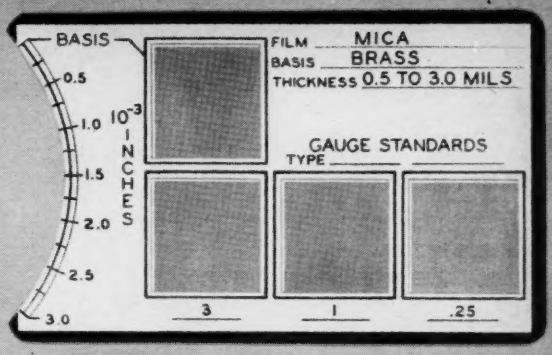
Once the appropriate standards and scales have been established, only two steps are involved in calibrating the instrument: (1) with the probe placed on a piece of reference material (usually a piece of the uncoated basis), the instrument is balanced with the tuning dial, until zero deflection is obtained on the meter; (2) the probe is moved to a coated sample of known film thickness, and the sensitivity adjusted until the meter deflection corresponds to the thickness of the sample.

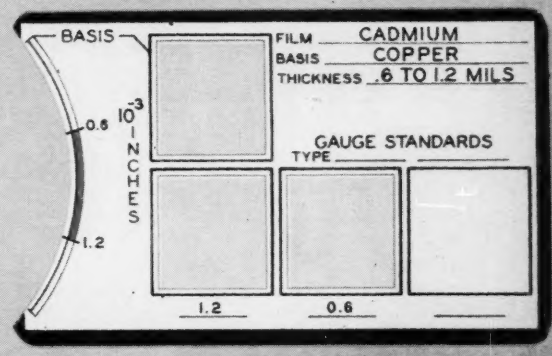
If the materials in the work are identical to those in the standards, the instrument is now ready for use.

However, slight differences in basis conductivities (or a moderate amount of curvature of the work) can be compensated by a modified technique. Having set up the instrument in the normal manner with the standards, the probe is moved to a piece of the actual basis (uncoated), and the tuning control adjusted until a new zero deflection is obtained. The accuracy of measurement is not noticeably impaired by this shift.

The effect of inhomogeneities in the basis materials in the actual work can be easily investigated. If the reading variations on different places of the basis material are considerably less than the readings (at the same sensitivity) obtained with the plating in place, the instrument can be used quite reliably.

Basically, the procedures outlined above are fol-





6. Non-conductive film on brass basis (top) and (at bottom) a cadmium plating also on a basis of brass.

lowed in all measurements with the film gauge.

Depending on the kind of measurement to be performed, several types of standards can be used for calibrating the instrument. The absolute accuracy of the instrument is determined by the accuracy with which the thickness of a standard is known. The instrument proper is capable of distinguishing thicknesses differing by a few percent of full scale reading.

(a) **"Basic"** standard. This type consists of a piece of the bare basis material, and three pieces of the same material, coated with accurately known thicknesses of the film material.

(1) In the case of a nonconductive film on a conductive basis, the required film thicknesses can be obtained easily by using mica as the film material. Firstly, all nonconductors look alike to the instrument; secondly, mica can easily be split into thin sheets (the thickness can be measured with a micrometer), and it can stand a considerable amount of wear and tear without damage. On aluminum, anodizing of the proper thickness makes an excellent, wear resistant nonconductive coating.

(2) In the case of conductive films on conductive bases, the coating has to be identical to that encountered in the actual work. In this case, one can start with two identical sets of three thicknesses each. All samples are measured with the instrument at the appropriate frequency, and the readings recorded. Then one of the standard sets is mounted on a standard card together with a sample of the bare basis material, while the other is measured by some other means for the actual coating thickness.

The readings obtained on this set can be plotted on graph paper as a function of the actual thickness, and a smooth curve drawn through the 4 points (3 thicknesses and basis). The thicknesses of the other, mounted set can then be read off the calibration curve so obtained. The calibration curve can be transferred to the edge of the sample card.

V_{osc} = const = $V_p + V_c$; oscillator tank voltage

V_{ref} = const, in phase with V_{osc}; reference voltage

I — current through C, coupling capacitor and probe circuit.

V_p — voltage across probe circuit.

V_c — voltage across coupling capacitor C; lagging 90° behind I

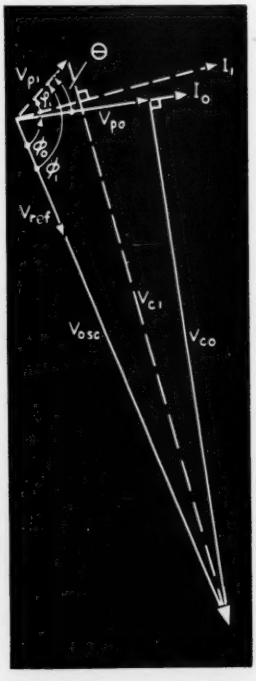
φ — phase angle of probe circuit.

ϕ — phase angle between V_{ref} and V_p

$\theta = \phi_1 - \phi_0$ = change of phase angle between V_{ref} and V_p due to a change of the phase angle of the probe circuit. (θ is the angle by which conduction angle of phase detector changes).

Subscript 0 — at probe resonance, $\varphi_0 = 0$

Subscript 1 — with detuned probe.



5. The vector diagram of the 255-A's probe circuit.

(b) **"Upside down" standards.** Measurement of extremely thin conductive films (less than one-tenth maximum measurable thickness) by the conventional method (that is, with the instrument balanced on the bare basis) usually does not give good results, particularly if the basis is also conductive. One of the main reasons for this is the reduced sensitivity of the instrument at low meter readings.

Improved sensitivity can be obtained by using a modified calibration technique. Instead of initially balancing the instrument on the bare basis, a sufficiently thick (more than the penetration depth) film of the coating material is used for the reference point. The instrument is balanced first on this thick sample, then the probe is moved to the bare basis and the sensitivity adjusted to give a reading near full scale. With this setting the two intermediate thicknesses required for the generation of a calibration curve are measured. After the calibration has been established, the thick film can be cemented on the card in the space provided for the basis, and the instrument used in the usual fashion. Using this technique, the meter readings will be "upside down" (see Figure 7 (c) compared with the normal method. That is, the thickest film will be at the top.

(c) **Synthetic standards.** Several of the common plating

metals are rather soft (e.g., silver, cadmium, etc.) and calibration standards using thin films of these materials will have a limited lifetime of usefulness because of wear at the point of contact with the probe spacer rod. However, these plated samples can be simulated by homogeneous specimens.

Once the calibration of the 255-A has been determined using the actual plated standards, a piece of a third material can usually be found that will give a deflection close to the thick end of the scale. After the "apparent thickness" of this piece of material has been noted, it can be used (together with a sample of the actual basis material) for calibrating the instrument. The original plated samples can be filed as "prime standards" and used only for preparing and checking calibration curves.

Since there is a multitude of alloy materials available (e.g., aluminum, brass, bronze, nickel, silver, etc.), it should not prove too difficult to find suitable standards.

Because the synthetic standards are homogeneous, wear caused by the probe tip will not change their "apparent thickness."

The synthetic standards can only be used at the frequency of calibration. With a change in test frequency, the "apparent thickness" is bound to change appreciably.

(d) **Standards for thin conductive films on nonconductors.** Metal foils and metallizing fall into this category. It has been found that readings obtained for this type of film are rather insensitive to the probe-foil spacing; the readings remain unchanged from contact between probe and foil to a clearance of about 1/32 in. Calibration of the instrument for this type of film can be performed simply by using multiple thicknesses of the foil to establish the calibration points. Imperfect contact between layers does not show up on the 255-A. This insensitivity of spacing makes possible the use of the instrument as a non-contacting foil thickness gauge.

(e) **"GO-NO GO"** standards. Often it is important only to ascertain whether a coating thickness falls within a certain range, without having knowledge of the actual thickness. Corrosion tests, for example, can determine the limits.

In order to prepare a GO-NO GO standard, only a piece of the bare basis and 2 coated specimens, at the high and low limits of the acceptance range respectively, are required.

These can be mounted on the standard card.

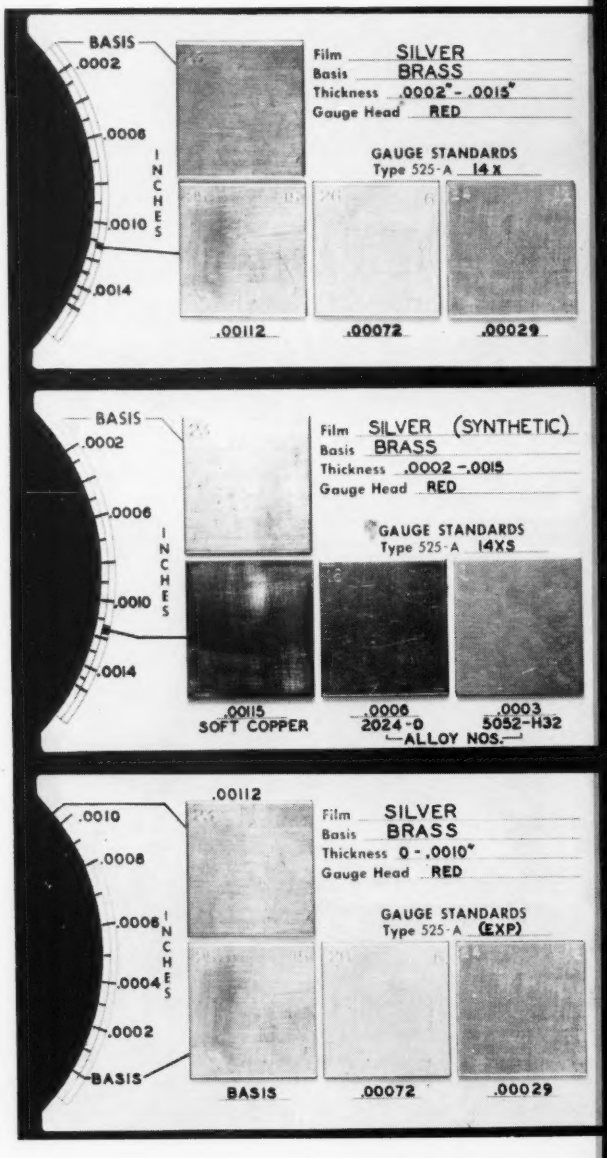
In addition to the standards described, some variations are possible.

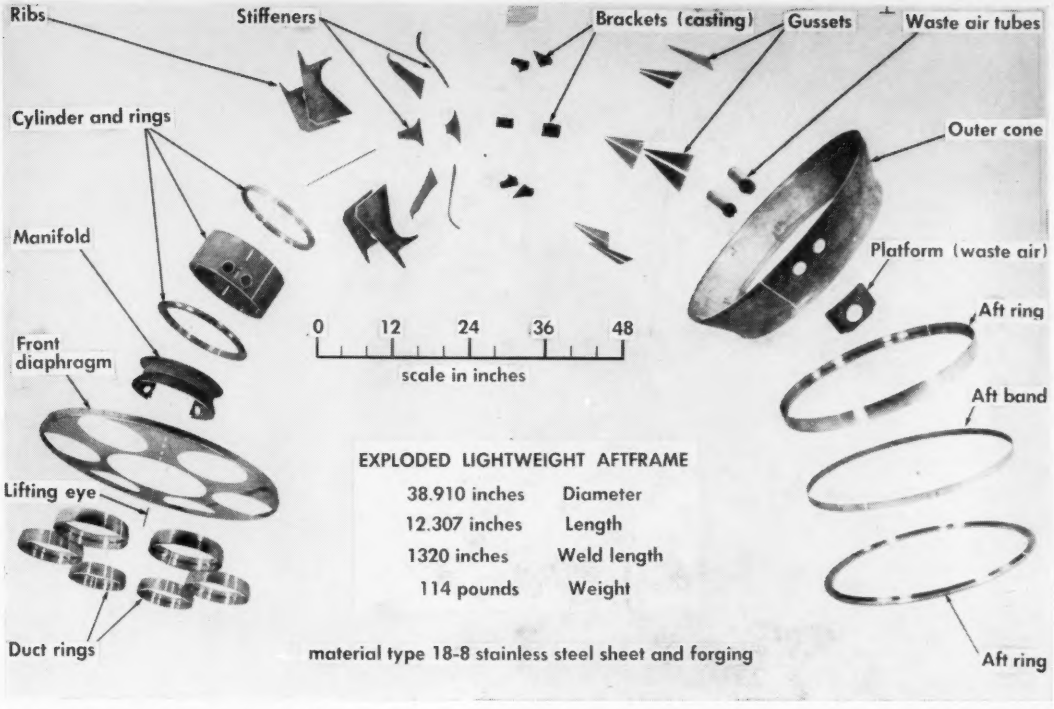
Normally, if strongly curved work is to be measured, it is necessary to use standards of the same shape, but in certain cases universal, flexible standards can be made up (e.g., for measuring plating thicknesses on large cylinders of different diameters).

In addition to thickness measurements, the eddy current method (and the BRC 255-A) can be used very successfully for material sorting. The instrument is balanced on a piece of the metal having the desired properties (e.g., a certain alloy), and the other pieces to be tested are checked with the instrument. Only pieces identical to the one used in setting up the instrument will give the same reading as the standard; all others will show different meter deflections. This method can be used on magnetic or nonmagnetic materials. It performs very successfully, particularly on the former and is, in fact, able to detect minute variations that would escape detection by other methods of inspection.

On the other hand, eddy-current methods should be used with caution if thickness measurements on magnetic basis material are contemplated: under certain conditions it is possible to get ambiguous readings. ★

7a, 7b and 7c (top to bottom). Meter readings from the lowest card will be "upside down" compared with the normal method. That is, thickest film at the top.





1. An exploded view of the aft frame clearly shows the various components that make up the complete assembly.

Aft frame redesigned for weightsaving

The aft frame of the Orenda engine used to be machined. Fabrication has replaced this design and, using half a dozen welding methods, has cut down the weight of the unit

Originally, the aft frame of the Orenda engine was machined but a lot of weight has now been saved by fabricating it.

An exploded view of the aft frame (Fig. 1) shows the various components that make up the complete assembly (Fig. 6). Most of these components are made from stabilized 18-8 type stainless steel sheet or forging. A total length of 1,320 in. of welding is required to produce each aft frame.

The welding methods employed are flash-butt welding, manual and automatic inert-gas-shielded tungsten arc welding, manual metal-arc welding and resistance spot and seam welding.

Each manual or automatic fusion or resistance welding process is established and approved by the Welding Department to produce joints within the quality requirements of the RCAF and Orenda Engines Limited.

The techniques used for the various welding operations are described below.

(1) **Automatic inert arc fusion welding.**

(a) Tack welding. The hand-operated tacking gun has a retractable tungsten electrode to strike, estab-

2. Manual inert arc welding, cylinder to diaphragm.

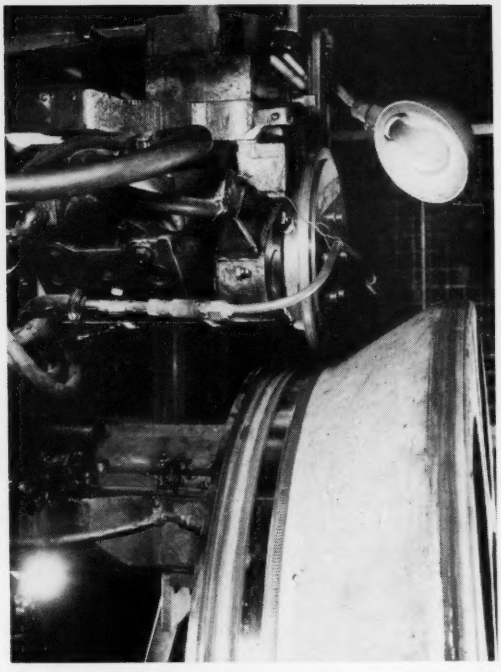
3. Manual metal-arc welding using flux-coated electrodes. This operation takes its power from a dc source.

lish and control the arc automatically. The welding time and argon gas flow are also controlled.

(b) Longitudinal welding. The equipment used for longitudinal welding has a d-c power supply, with a high frequency starting. The clamping pressure is applied pneumatically and filler wire is fed in (if required) at a controlled rate.

(c) Circumferential welding. Is carried out using expanding fixtures which can be rotated at a constant speed. Filler wire is fed in at a controlled rate and

4. Resistance spot welding of the cone to the aft ring. A portable 100 kva capacity welding machine is used.



5. Resistance seam welding, cone to aft ring. Flood cooling can be used during the welding if required.

the arc voltage controlled automatically within 1/10 volt to maintain the arc length within ± 2½% and produce a consistent weld bead.

(2) **Manual inert arc fusion welding.** The manually operated torch is shown in use in Fig. 2. Argon is used as the shielding gas, with a d-c power supply. Filler wire is added when required.

(3) **Manual metal-arc welding.** Metal-arc welding using flux-coated electrodes, is illustrated in Fig. 3. A d-c power supply is used.

(4) **Resistance welding.**

(a) Tack welding. A portable 100 kva capacity spot welding machine is used. This equipment (Fig. 4) operates on a single-phase a-c power supply.

(b) Seam welding. A three-phase 100 kva seam welding machine is shown in operation in Fig. 5. Flood cooling can be used during welding, if required.

(5) **Flash-butt welding.** Flash-butt welding, employing special fixtures, is used to join up the rings, rolled from bar material.

The band, cylinder and cone are rolled from 0.080 in. and 0.125 in. type 18-8 stainless steel sheet material, then butt-welded by automatic longitudinal inert arc fusion welding (process 1(b)) and machined (or spun and machined) to shape. The speed is 20 in. per min.

The rings are rolled from type 18-8 stainless steel forged bar, flash-butt welded (process 5) and machined.

Joining of subassemblies. The two aft rings are tacked to the aft band by inert arc spot tacking (process 1(a)), and then joined by automatic circumferential inert arc welding (process -(c)). The rings and band are mounted on an expanding fixture with a grooved copper backing ring.

The same methods are used to join the inner cylinder to its end rings, and to join the outer cone to the front diaphragm.

The ribs and stiffeners are joined together by the manual metal arc welding (as shown in process 3). ★

Final Assembly
Sequence of Operations

(a) **Cylinder to front diaphragm.** Joined by manual inert arc welding (process 2), as shown in Fig 2. A heavy clamping plate is used to hold the components, and filler wire is added during welding.

(b) **Ribs to cylinder.** Manual metal arc weld, through slots (process 3).

(c) **Ribs to diaphragm.** Manual metal arc weld, again through slots (see Fig 3).

(d) **Stiffeners to cylinder ring.** Joined by manual metal arc welding (process 3).

(e) **Cast brackets to stiffeners.** These brackets are cast from 25-20 type stainless steel, and are manually metal arc welded (process 3) to the 18-8 sheet stiffeners using direct current and an ⅛ in. diameter electrode of the 29-9 type.

(f) **Outer cone to aft ring assembly.** Tack welded using resistance spot welding (process 4a), as shown in Fig 4 and then seam welded (process 4[b]). Thicknesses of 0.078 in. and 0.122 in. are joined at a welding speed of 9 in. per min (Figure 5).

(g) **Gussets to ribs and to aft ring.** Joined by manual metal arc welding (process 3).

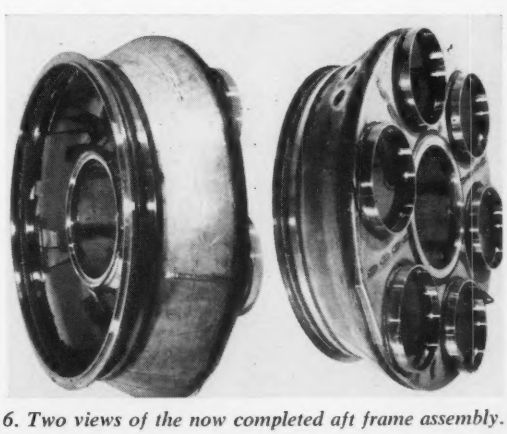
(h) **Waste tubes to cylinder.** Manual inert arc welding (process 2). No filler wire is required for this joint.

(i) **Waste tubes to outer cone.** Manual inert arc welding without filler wire.

(j) **Duct rings to diaphragm.** Joined by manual metal arc welding (process 3). Heavy jigging is required to prevent undue distortion when welding these relatively light components.

(k) **Manifold to cylinder.** This is tacked by resistance spot welding (process 4[b]), and joining completed by manual inert arc fusion welding process 2).

(l) **Waste air platform to outer cone.** Manual metal arc weld (process 3).

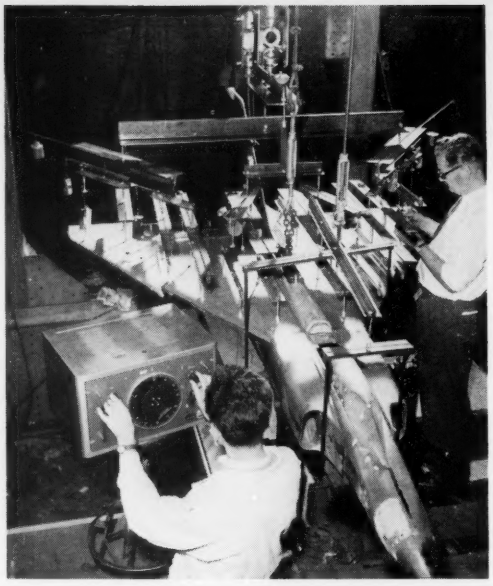


6. Two views of the now completed aft frame assembly.

Design news in pictures

Shaping the future

Intermediate step in the styling of a new car is the translation of the artist's drawings into a full scale mockup in clay. It's back to those modelling days at school for these Ford craftsmen as they fashion the "horned toad look." (200)

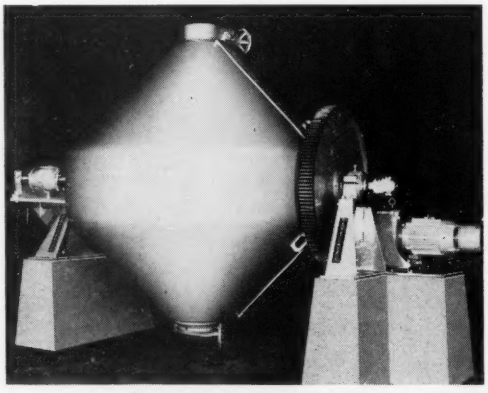


Backroom boys

Before the well-earned glare of publicity marking the public showing of the CF105 Arrow stretched a long road of extensive research and testing. Here Avro men check gauges on a free flight model. (202)

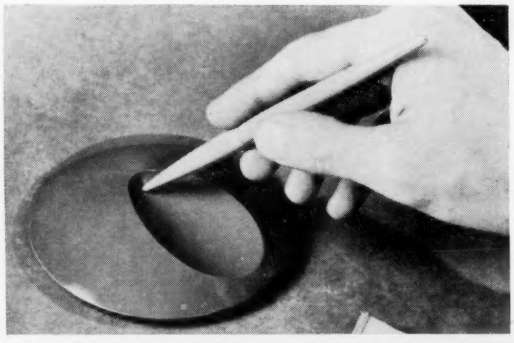
Three times a day after meals

Pills of every conceivable shape and size for many hundreds of uses come from dies like this. Polyglycols are an essential ingredient in the process of making these gelatin capsules to contain medicine, lighter fluid and the like. (201)



Keeping the powder dry

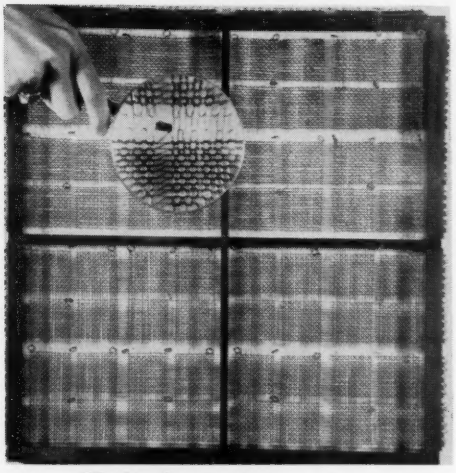
The largest vacuum dryer of its type (9 ft. in diameter) has recently been installed in Quebec. It will be used in the vacuum-drying and blending of valuable chemicals and crystalline particles. (203)



The desk set

Currently on the market is this pleasingly simple desk set. The color is molded through. Base is of a melamine plastic. (204)

Some modern designs making news today



Elephantine memory

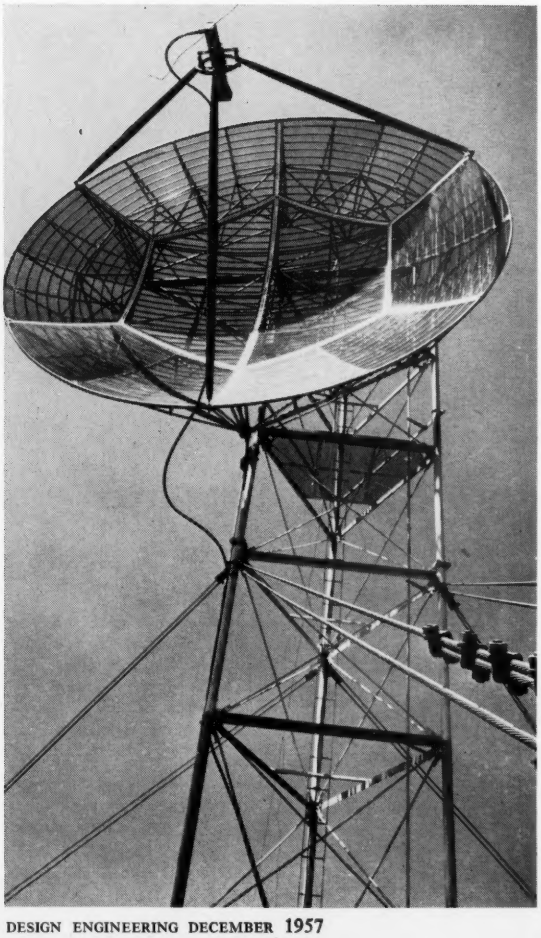
Probably largest memory assembled as a single unit, this took more than 400 hrs to assemble. There are 16,384 cores threaded onto the lattice. (205)

Easy to clean

A really clean faucet design is this one of brass with polished chromium plated finish. It has a complete drain-off seat. (206)

Like a lipstick

Nail polish is a cinch to apply with this device. A small brush slides forward with enough for one fingernail at a time. (207)



Big ear

UHF signals are normally limited to line of sight transmission. This is picking up that small part of those signals out of the troposphere. (209)

Blowup for small parts

A quick way of enlarging small parts for accurate measurement, this microprojector has a horizontal stage for positioning the work, an inclined screen for the image, a choice of magnifications, horizontal measurement. (208)

Ideas round-up

Zirconium fittings: stability under radiation

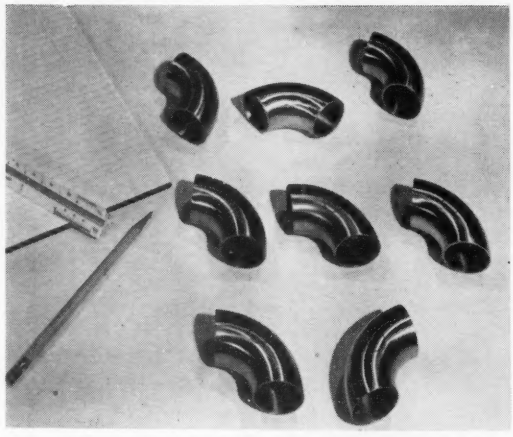
What are believed to be the first welding fittings of zirconium and Zircaloy 2 have been forged by **Tube Turns,** a division of National Cylinder Gas Company. They were designed for a nuclear energy application.

The fittings have an outside diameter of 1.5 in. and a wall 0.065 in. thick.

Designers of piping in the chemical and nuclear fields are specifying zirconium and Zircaloy 2 in increasingly large quantities where severe corrosion conditions are met.

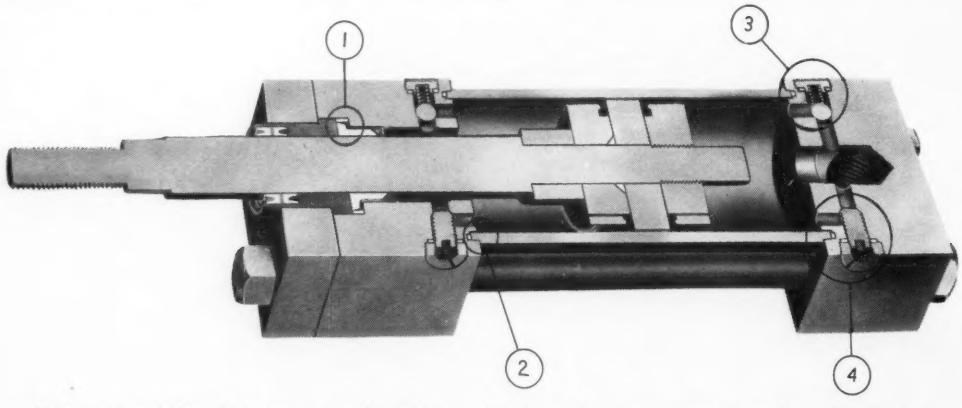
Laboratory tests and field experience show that these materials have a combination of desirable properties, and that they can effect important economies when properly applied. In addition to excellent resistance against attack from a wide variety of corrodents, they have a very low thermal cross-section (0.18 Barns) and possess relatively good strength up to moderately high temperatures.

When employed in nuclear reactor installations, they have a high degree of stability under radiation. (210)



Some pipe fittings made in zirconium and Zircaloy 2.

Cylinder sealing: a resistance to all fluids



Tube end seal (2) of Teflon and rod bushing seal (1) of the same material replace the O ring seals which were subject to extrusion and shearing. A new cushion adjusting screw (4) which is flush with the head or cap has a self-regulating Teflon lock seal. Now located directly opposite the adjusting screw is the redesigned ball check (3)

Design changes made by Miller Fluid Power Division of Flick-Reedy Corporation have made possible the first all-Teflon sealed cylinder with universal resistance to fluids.

These design changes will make it possible to increase pressure ratings on the entire line of high pressure hydraulic cylinders and to introduce a completely new line of medium-to-high pressure hydraulic cylinders.

Simpler servicing, because the possibility of shearing is eliminated, is another advantage resulting from the seal design developments. The changes include a new tubing and seal and a new piston rod bushing seal. These permit the use of Teflon sealing rings instead of the synthetic rubber O rings that were previously used.

In addition, a new cushion adjusting screw (with a self-regulating Teflon lock seal) is being introduced. Located in the head or cap end, the adjusting screw is now directly opposite the ball check (also re-designed) and is interchangeable with it.

The new pressure energized tubing end seal design called the SHEF seal (for its resistance to shear, heat, extrusion and fluid), has made it possible for the firm to boost the pressure on its entire line of high pressure cylinders. Ratings have gone from 2,000 psi (shock) or 3,000 psi (non-shock) to 3,000 psi (shock) or 5,000 psi (non-shock).

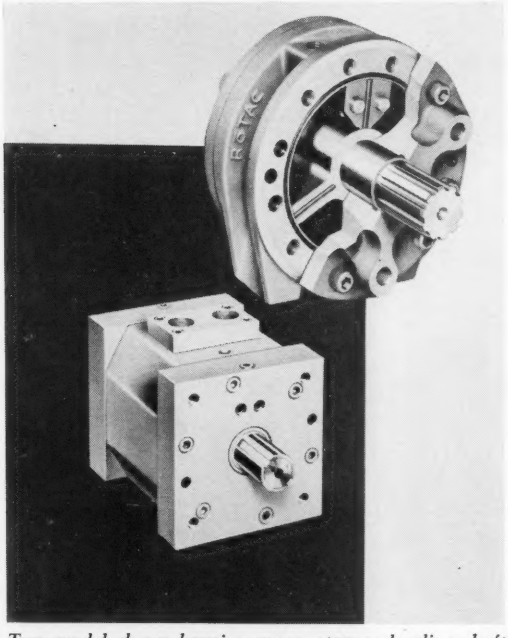
Bore	*Normal shock operating ratings*	*Normal non-shock operating ratings*
1½, 2¾ in.	1,500	2,500
2½ and 4 in.	1,000	1,500
5 and 6 in.	800	1,200
8, 10, 12 and 14 in.	500	800

(211)

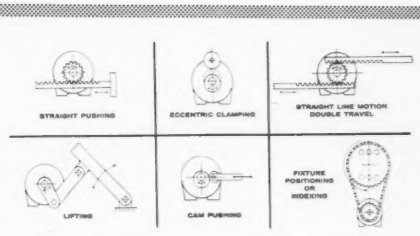
Actuator: pull, push, lift, lower, open and close

New applications for Ex-Cell-O's high torque Rotac reciprocating actuator are accounting for its increasing popularity and acceptance.

The unit can be used for such movements as pulling, pushing, opening, closing, lifting, lowering and many other applications. The actuator is of simple design and construction; power can be from oil, water or air.



Top model shows housing, vane, stop and spline shaft.



Typical applications of rotary actuators.

The device is composed of a cylindrical chamber containing a stationary stop and a central shaft on which a vane is fixed. The assembly is enclosed by cylinder end caps, through which the shaft projects. When pressure is applied to either side of the vane, the shaft rotates in the direction in which the pressure is applied. Pressure reversals provide reciprocating movement. Movement is limited to a maximum arc of 280 deg by the stop within the cylinder.

Standard models develop a torque of 150 to 300,000 in.-lb at an input pressure of 1,000 psi.

Positive control is achieved by valves, which permit starting, stopping, increasing or decreasing speed. Torque can be doubled by using two vanes instead of one, with the circular travel reduced to 100 deg. O-rings prevent leakage around the vane, stationary stop and end caps.

The normal operating position is with the body stationary, while the shaft rotates. This arrangement may be reversed, however, so that the body rotates around the stationary shaft. Shafts may be splined or keyed: single or double end. (212)

Sandwich structure: boon to missile development?

One of the first sandwich-type, load-carrying missile structures fabricated of reinforced plastics successfully to undergo sever static tests was recently developed by **Narmco, Inc.,** Research and Development.

The test component (of about 5 ft diameter and 8 ft long), weighed only 71.5 lb, as compared with 166.9 lb for a metal counterpart and tested to 200% of the ultimate load at 650 F without failure, during tests at Wright Air Development Center.

The lightweight, sandwich-type missile shell, designed to withstand the same loads and temperatures as a similar metal component, was fabricated of pre-cured skins of 143 and 181 style glass cloth impregnated with X-183 phenolic resin.

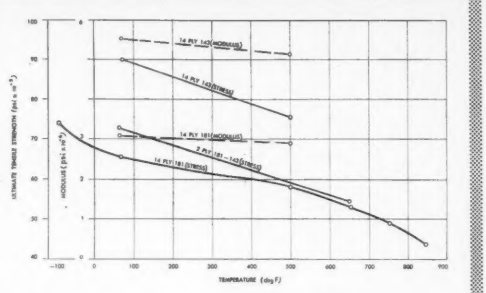
Aluminum honeycomb core material was selected, because the greater heat transfer through aluminum pro-

vided a lower temperature gradient between the inner and outer skins than would have been possible with a glass core.

Uniform temperatures were maintained throughout the shell due to the absence of stiffeners, thus eliminating the effects of compressive thermal stress and provided outstanding aerodynamic smoothness.

During static tests the component was subjected to transient high temperature conditions that might exist in actual flight trajectories of a missile. In the maximum moment test, the shell was subjected to a skin compression stress of 18,400 psi without failure, and during the maximum temperature test the cycle was such that the outer skin was at 650 F. The tests were not carried to destruction because of the expensive equipment that might have been damaged.

Properties of the phenolic-glass laminate from which the skins of the missile component were made are presented in the accompanying graph showing results of tensile test at temperatures up to 850 F. At temperatures of 500 F (or less) specimens were soaked at test temperatures for 30 min prior to testing. At test temperatures above 500 F, the exposure time was reduced to approximately 2 min.



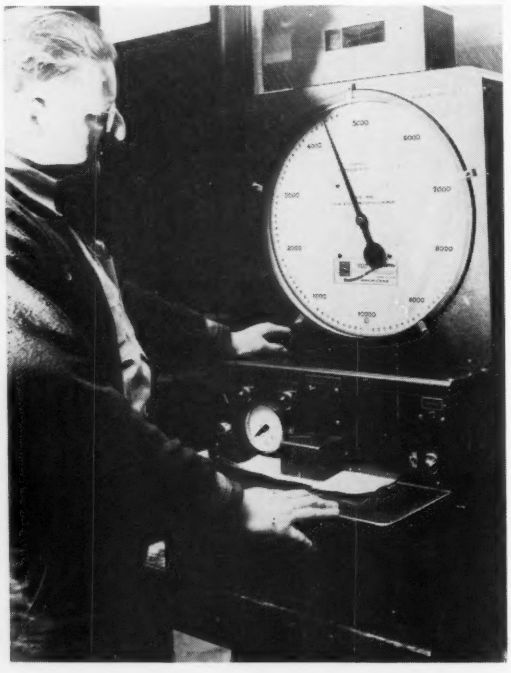
Properties of the phenolic-glass laminates.

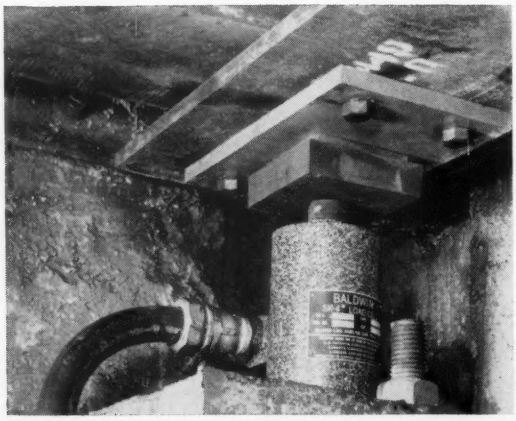
The successful testing of the sandwich type, reinforced plastic shell indicates the potential use of this type of structure in the manufacture of future air weapons in the missile-development program. (213)

Electronic scale: load cells on the job

Accuracy is the important factor in weighing steel for shipment. Any variation in weight in a shipment of several tons of bar or rod would mean a speedy complaint from the customer.

One important type of scale is the electronic system using Baldwin SR-4 load cells.





Left: Weight of load on platform, located 50 ft from office, is shown on dial and printed on the ticket. Above: Close-up of a load cell in use beneath pipe-weighing scale platform. Cells support the platform.

The system is used to weigh rods, rounds, flats, drill collar bars and other steel products, being shipped directly to customers. The weighing operation is a continuous one with the scale in use approximately 180 times during the three-shift, 24 hour period. Total weights of individual loads vary from 3 to 5 tons. Much of the stock ranges up to 35 ft long. Larger lengths must be propped by timers during weighing operation.

The system uses SR-4 load cells manufactured by the Electronics and Instrumentation Division of Baldwin-Lima-Hamilton Corporation.

In place of a mechanical linkage, four 10,000 lb

Continued on page 68

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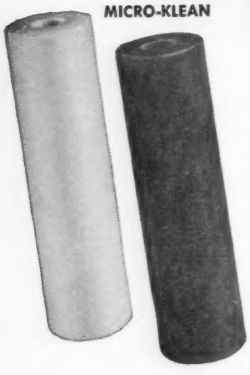

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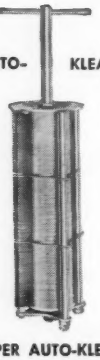

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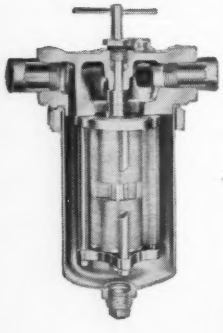

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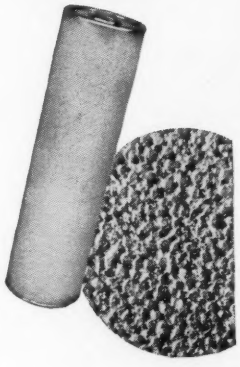

FLO-KLEAN

MICRO-SCREEN

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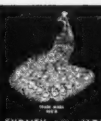

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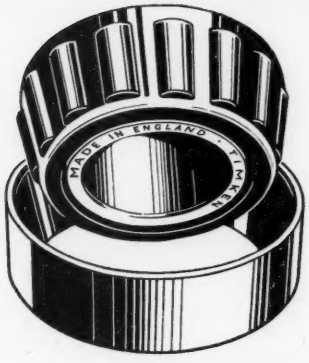

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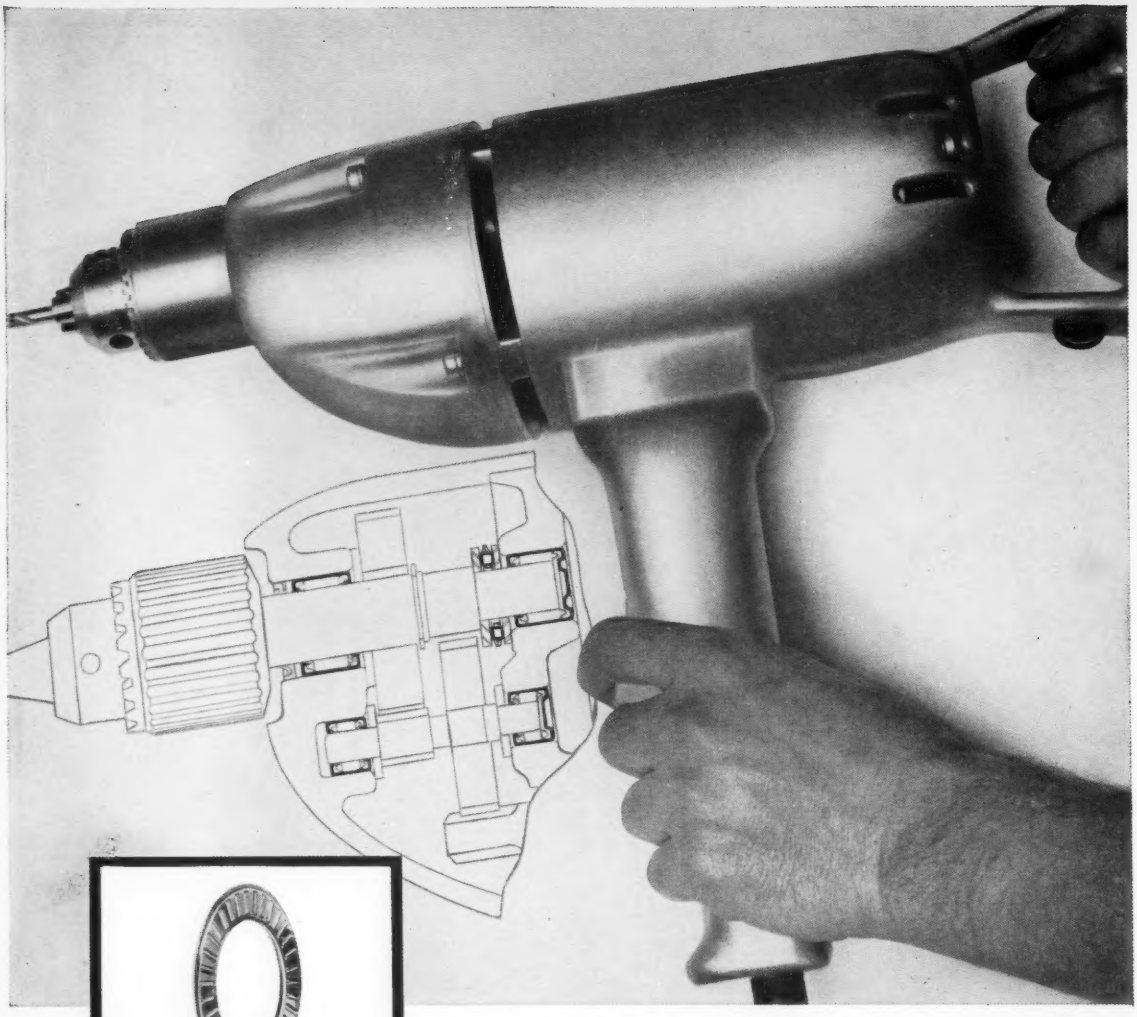

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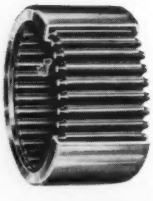

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compression type CXX load cells are mounted beneath a platform on concrete piers. 3 in. bearing blocks (resting on the collars of the load cells) support the weighbridge at the four corners, check rods being installed to provide the necessary lateral support. The load cells are then wired into the electronic circuit.

The scale dial mechanism is located about 50 ft from the platform. This has several advantages, for the shipper is in no danger of injury from bars swinging in the crane slings and the scale dial mechanism cannot be damaged by a shifting load of rod. Because the SR-4 load cells are self-enclosed, dirt, dust, grease or liquids cannot damage the cell interiors.

Engineers point out that one of the virtues of these load cells is that there are no mechanical parts to wear out. There is no knife edge or agate bearing or hydrauic system to maintain, and there are no pivot points to lubricate. Since the load cells are constructed to carry heavy loads, and to withstand physical shock and vibration (and yet be sensitive enough to indicate the slightest variation in weight) the savings in inspection and maintenance cost are appreciable. (214)

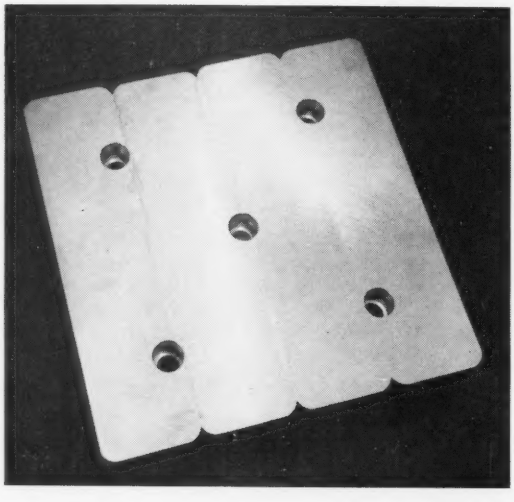
Wear plate: oil impregnated and self-lubricating

One of the biggest contractors in the U. S. needed a large self lubricating wear plate that would withstand the tremendous nozzle thrust in the latest Air Force supersonic wind tunnel. The original lubrication had to last the life of the tunnel, since once in place it could not be lubricated.

The Apex Bearings Company (in conjunction with the Amplex Division of Chrysler Corporation) solved the problem by using super oilite. By means of a new approach in the field of silver solder bonding, four oil-impregnated pieces of this material (as plate stock) were brazed together to form wear plates 12 in. wide x 12 in. long x 2 in. thick.

The wind tunnel contains 36 of these wear plates and they must withstand loadings up to 14,000 psi. The soldering, drilling and counterboring did not affect the self lubricating qualities of the material.

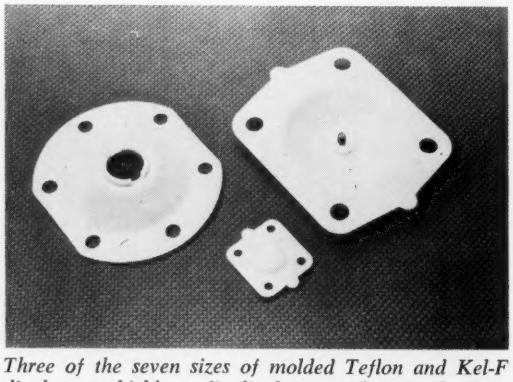
The use of plate stock in this way was the solution to a seemingly impossible task. Silver solder bonding by this new method (patents applied for) is applicable to all powdered metal bearings and parts. (215)



Diaphragm shield: unaffected in boiling acids

Seven sizes of standard molded Teflon and Kel-F diaphragm shields to fit diaphragm valves in the 3 in. (and under) size range have recently been marketed by the United States Gasket Company, Plastics Division of The Garlock Packing Company. These shields are installed over a rubber diaphragm to provide corrosion and heat resistance, and are unaffected by the chemicals normally found in industry. They are attacked only by molten alkali metals, chlorine trifluoride and fluorine at elevated temperatures and pressures. They are not affected by alkalis in any concentration nor will they swell or change weight when boiled in solvents or acids. Temperatures of 350 F (and higher) are possible where low line pressures exist, that is, approximately 30 psi.

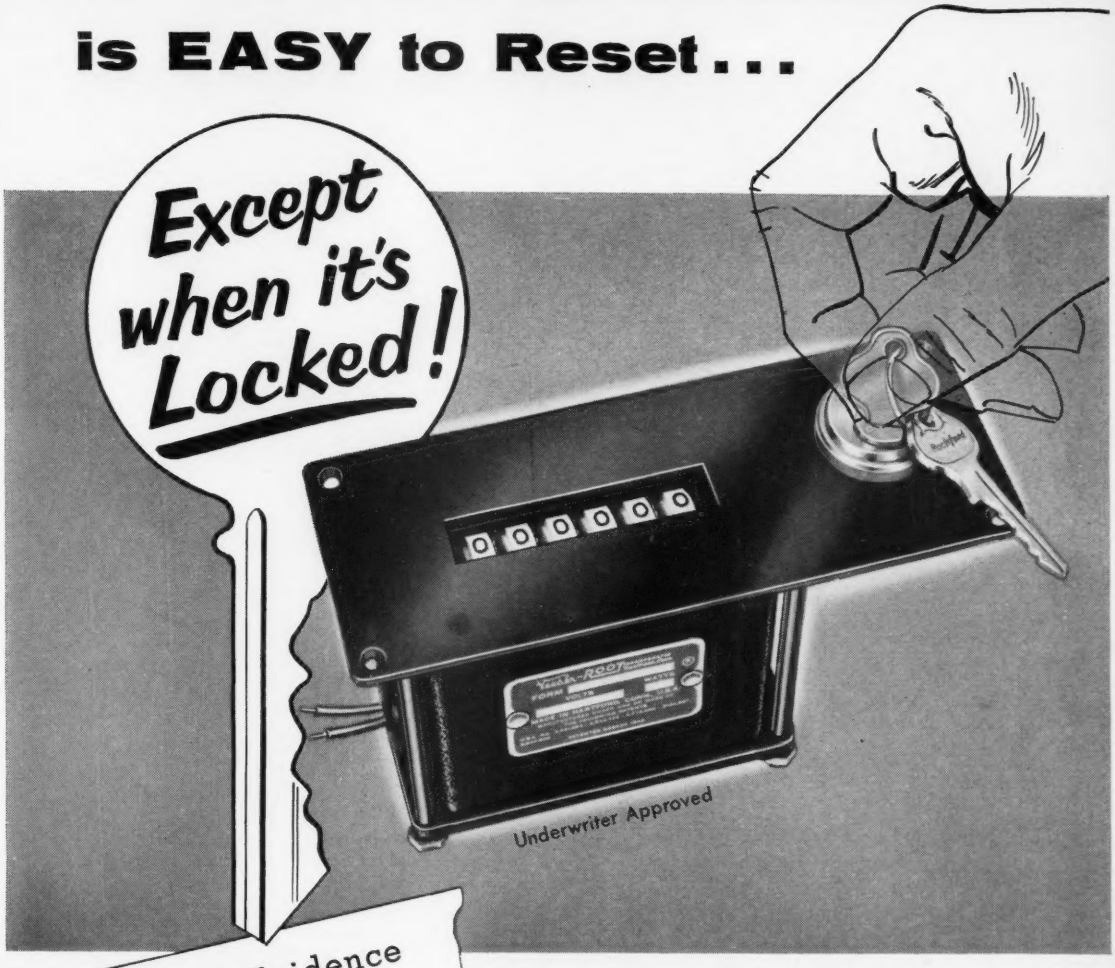
Diaphragm shields are tested for pin holes by exposing the diaphragm surface to 30,000 volts. Shields have also withstood cycle testing using water at 90 psi, surpassing 100,000 cycles, after which the diaphragm still withstood the 30,000-volt spark test. (216)



Three of the seven sizes of molded Teflon and Kel-F diaphragm shields to fit diaphragm valves in the 3-in. and under size range. They install over a rubber diaphragm and will provide corrosion and heat resistance.

Continued on page 70

This NEW Magnetic Counter is EASY to Reset...



Added Evidence that—

Everyone Can Count on VEEDER-ROOT

Designed for panel mounting where remote indication is required, this electrically operated counter is a compact package 5.5″ long, 2.1″ wide, 2.7″ high. Capacity: 1,000 counts per minute. Power consumption, 8 watts. Stocked in 110 and 220 AC and DC. Easy to reset, except when locked . . . then the sturdy tumbler-lock* puts the damper on tampering. Yet one turn of the key resets all 6 figures to zeros.

This new Magnetic Counter is one of the thousands of Veeder-Root standard and special counters . . . electrically, mechanically and manually operated . . . in daily use throughout the world in industry, business, science and medicine. You, too, can count on Veeder-Root . . . to help you count anything you need.

*National Lock Co. Lock No. 68-4837; Key D-428

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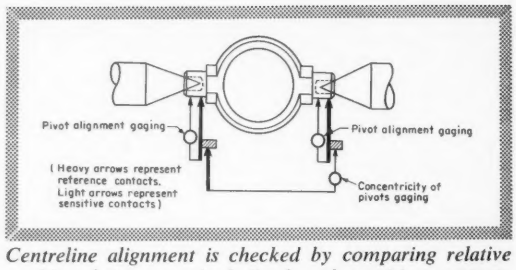
"THE NAME THAT COUNTS"

Precision gauge: checking gimbals for alignment

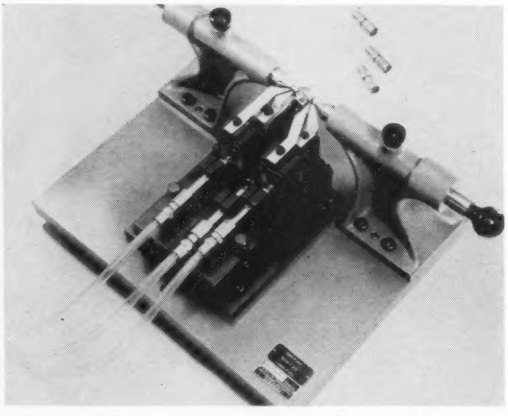
A special gauge has been developed by Federal Products Corporation to check gimbals for alignment of each pivot with the centreline of the gimbal and concentricity of one pivot with the other. The three readings are indicated simultaneously on dials of a triple-unit Dimensionair air gauge. Dials on gauges supplied were graduated to 20 millionths of an inch. Since the gauge makes three checks simultaneously with a single handling of the workpiece, it has greatly reduced the time required to determine part acceptability.

As developed for a manufacturer of missile guidance systems, the Federal gauge has a fixture containing precision centring stocks which support and position the gimbal during the gauging operation. The gimbal is rotated to obtain total indicator readings. Any lack of alignment between a pivot and centreline of the gimbal will be evidenced by a wobble of the pivot as the piece is rotated. This motion will change the relative position between a pair of contacts bearing on either end of each pivot. Since each pivot alignment is checked separately, the two side-by-side platforms are independent. An Air-Probe gauge head, solidly mounted on each platform, contacts the sensitive pantograph and transforms its motion into a corresponding air pressure variation which is magnified within the triple unit Dimensionair and displayed on each of the outer dials.

Since the reference contacts are solidly mounted to their respective platforms (and since the two platforms are independently pantograph mounted to a common base) concentricity can be checked by comparing the position of one platform so that its plunger bears against a shoulder on the other. Total indicator reading for concentricity is shown on the middle dial of the triple-unit Dimensionair. Acceptability tolerances for alignment and concentricity in this application are 0.0001 in. (217)


Pivot alignment gaging
Pivot alignment gaging
(Heavy arrows represent reference contacts. Light arrows represent sensitive contacts)
Concentricity of pivots gaging

Centreline alignment is checked by comparing relative position between paired fixed and sensitive contacts.



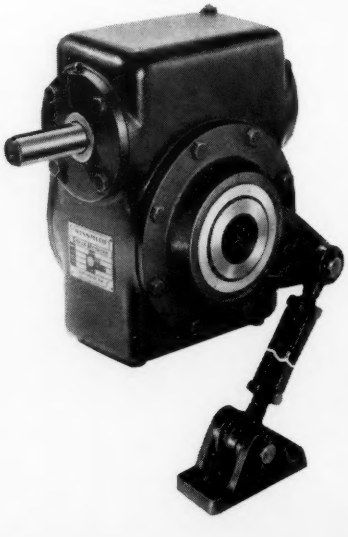
Shorter contacts are reference contacts rigidly mounted to their respective sides of the split platform.

Speed reducer: a direct-mounting spacesaver

Two shaft mounted, worm gear speed reducers have just been announced by Winsmith, Inc. They are Series ST (a torque arm type) and Series SF (a flange mounted type). Both are currently available in three sizes with ratios ranging from 7½:1 to 77:1, with a horsepower range of 0.63 to 8.82 and a maximum output torque range from 816 to 7,678 in. lb. The speed reducers mount directly on the shaft of the driven machine and thus require less space than conventional reducers, because couplings and bed plates are thus eliminated.

The slow speed shaft of both types is provided with two external slots to facilitate the removal of the reducer from the driven machine by using a standard wheel puller. This eliminates undue force on the reducer bearings during disassembly.

The ST series reducer is complete with torque arm and fittings. The torque arm may be used either in tension or compression and its position may be varied by shifting the cover on which it is mounted. (218)



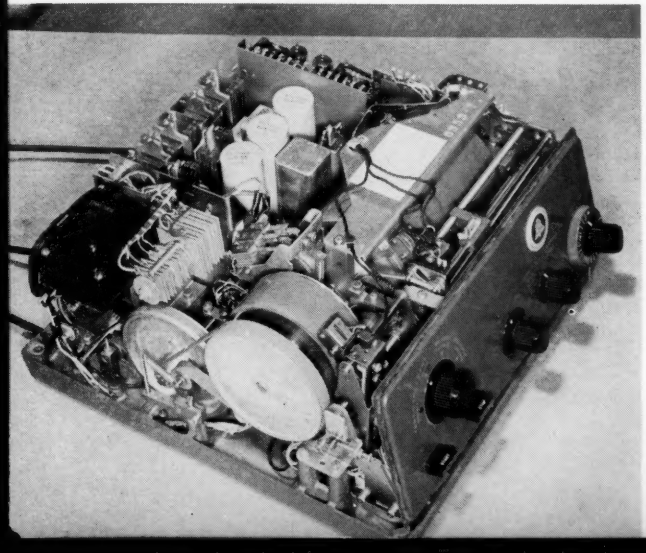
Robot secretary answers the telephone and takes messages

When your secretary heads for lunch, this will keep incoming calls on ice

The Bell Telephone has introduced a "secretary" who never takes a rest period, is always on the job and never says anything original. On the other hand, however, she does repeat faithfully everything she's told.

There are two styles. One is called the automatic telephone answering and recording set (1BA set); the other is known as the automatic telephone answering set (2A set).

The two types of automatic answering service are supplied by equipment installed in an office or home. Every time the telephone rings, a message (pre-recorded by the subscriber) automatically starts to play-back to the caller. If the equipment is the 1BA set (which includes a caller-message recording device) the caller, after listening to this pre-recorded message, can (if he wishes) dictate an answer. Thus the equipment automatically answers a call with a pre-recorded announcement and then records a message from the caller.



On the 1BA set, the pre-recorded announcement may be up to 30 sec long. After this the caller has 30 sec in which to record his message. A pair of beep signals indicates to the caller when he may start dictating his message. A similar pair of signals sounds 2 sec before the end of the recording period. In all, callers may leave up to 10 min of recorded messages, but a single message cannot be more than 30 sec in length.

The 2A set, supplying only the automatic answering service, provides for a recorded message up to 60 sec long to play back when the number is called.

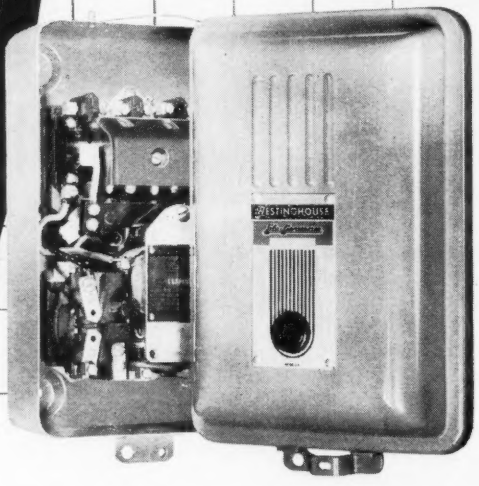
These sets (for use in 60 cycle areas only) can be installed on individual manual (common battery) or dial telephone lines. They can also be used on private switchboard extension lines. They are not available for party lines.

The 1BA set is contained in a table-mounting unit enclosed in a gray metal cabinet about 14 in. x 15½ in. x 7 in. high, the whole weighing approximately 45 lb. ★

MORE HORSEPOWER!

LESS COST!

SMALLER SPACE!



with Westinghouse rerated motor starters

Here's real news for cost-conscious, space-conscious electrical planners.

Westinghouse Life-Linestarters (sizes 0 and 1) *have been uprated* . . . giving you the advantages of more horsepower, less space, lower cost!

For example: if you've been controlling a 550-volt, 5-hp polyphase motor with a size 1 starter, you can get the identical control and protection with the smaller, less costly size 0 starter.

And speaking of performance . . .

Only Westinghouse starters have the De-ion arc quencher, which greatly increases contact life by reducing burning and pitting.

Westinghouse starters utilize high-strength, non-carbonizing Rosite insulating parts for maximum safety and operating life.

Westinghouse starters have double-break, silver-to-silver contacts for longer life and greater dependability.

What's more, the entire starter line is designed to simplify installation and maintenance — featuring front-removable parts and straight-through wiring.

For the full story, contact your nearby Westinghouse sales office, or write Canadian Westinghouse Co. Ltd. Hamilton

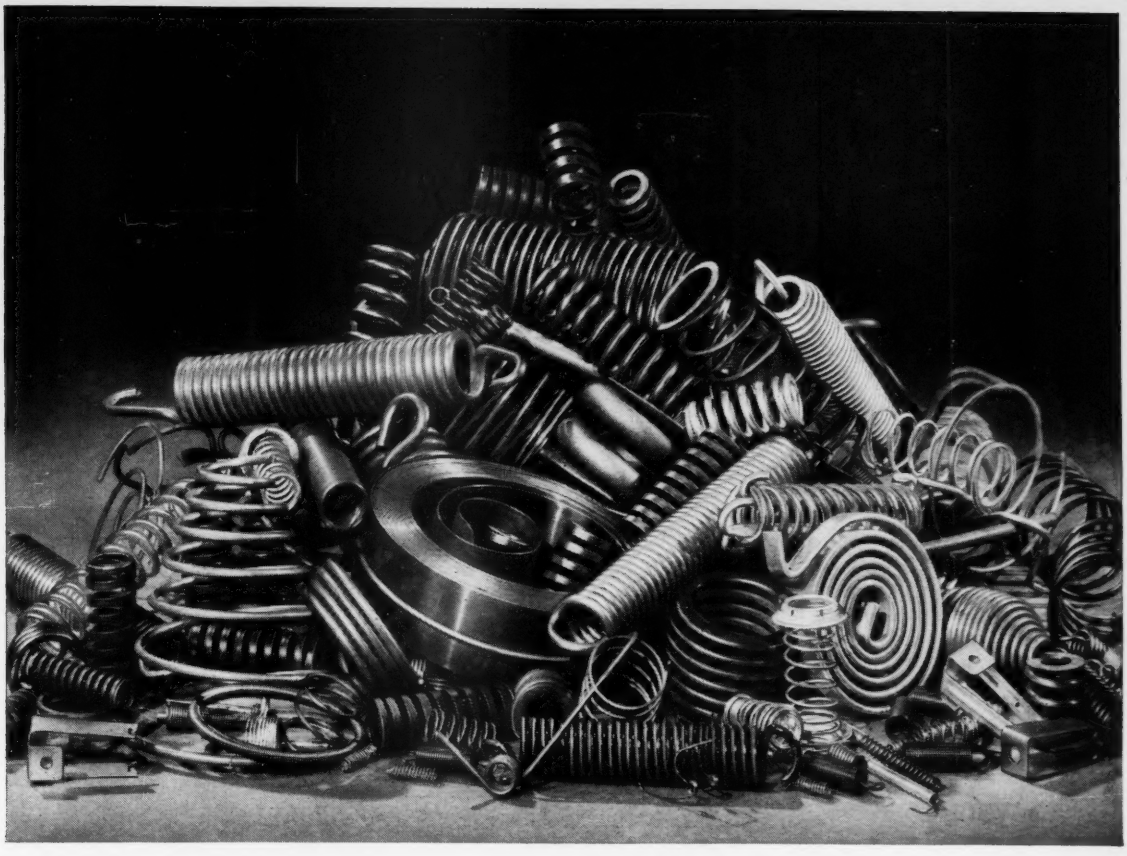
CEMA SIZE	110 Volt				220 Volt				440 550 600 Volt			
	1ø		3ø		1ø		3ø		1ø		3ø	
	Old Rating	New Rating	Old Rating	New Rating	Old Rating	New Rating	Old Rating	New Rating	Old Rating	New Rating	Old Rating	New Rating
0	1	1	1½	2	1½	2	2	3	1½	3	3	5
1	1½	2	3	3	3	3	5	7½	5	5	7½	10

Westinghouse uprated starters give you: More horsepower — in eight new starter ratings. Less cost and space — in applications where the rerated size 0 starter replaces the size 1 starter, and the size 1 replaces the size 2.

YOU CAN BE SURE... IF IT'S Westinghouse

57B480

Enjoy Television's Top Dramatic Show, Westinghouse **STUDIO ONE,** *every Monday night*



needle in a haystack?

Finding just the right spring can be costly and time-consuming. Even though springs look alike, each is different—depending on the job it has to do. Type, size, tension, temper, stress, and other complicating factors must be considered in their design and manufacture

If finding the right spring for *your* problem seems like "looking for a needle in a haystack," Wallace Barnes can help you. Our spring engineers are ready to accept your precision mechanical spring problem and help design the *right* spring to do your job *precisely* right.

Send for your free copy of
Spring Design and Selection—in Brief
our authoritative digest on spring engineering

Selecting the right spring is simple . . .

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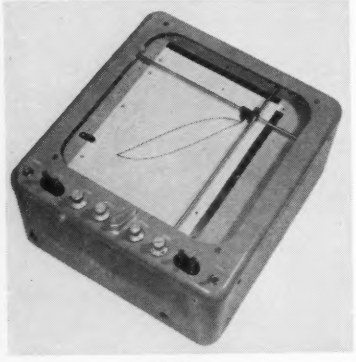
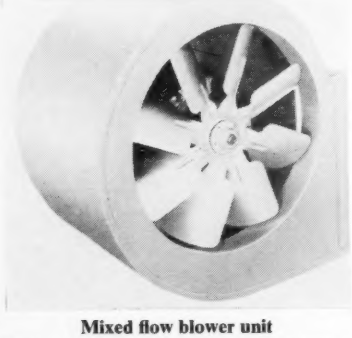
New products & materials

Suspension balancers
They have an automatic safety brake.



Plotter
It's redesigned, repackaged as well.



Mixed flow blower unit
Suited to furnaces, air-conditioners.

Automatic micrometer
Precision measuring fragile parts.

Suspension balancers

Two new low-price, streamlined suspension balancers (featuring Thor's exclusive automatic "no-drop" safety brake for the safe and convenient handling of air and electric tools, inspection gauges, welding and other equipment up to 10 lb in weight) have been introduced by **Thor Power Tool Company.**

The new balancers are the Model 5LB6, to suspend loads up to 5 lb in weight, and the model 10LB6 for equipment weighing from 1 to 10 lb. The built-in brake on both models prevents loads from dropping under any circumstances. In addition, both new balancers have a full swivel upper hook for easier handling and longer life, with an auxiliary suspension provision for double safety.

The spring-reel cable devices hold equipment at operating levels and provide for automatic retraction to any handle level between operations. The balancers (which have a 6 ft travel range) are extremely adjustable for cable tension and travel, as well as for operating and out-of-the-way levels.

Other features of the LB series balancers include nylon sheathed steel aircraft cable, rubber cable stop and heavy gauge steel housing.

Balancers are being used increasingly in industry to speed production by eliminating weight and fatigue factors from portable tools and by shortening the tool-handling cycle. They save replacement and maintenance costs, too, by preventing damage to tools as a result of their being dropped, walked on or run over by industrial vehicles. (219)

Plotter

The ER-90 X-Y plotter, completely redesigned and repackaged, is now available from **Mandel Industrial Instruments.** With an input sensitivity as high as 1 millivolt per inch, this plotter features a flat bed construction for full chart visibility and a slip-on pen plotting on standard 8½ in. x 11 in. paper. Reliable operation is insured by conventional chopper-stabilized amplifiers and standard 3 turn rebalance potentiometers in the null-seeking servo system, plus a simplified cord drive system. The two axes are electrically independent. (220)

Mixed Flow Blower Unit

A symmetrically constructed, direct drive blower, with power and pressure characteristics ideally suited to furnace and air conditioner applications, is the **Torrington** "Radiax."

There are four models, covering a flow range from 500 to 1500 cfm against typical back pressures.

Manufacturers of furnaces and air conditioners will find the following characteristics significant in terms of the over-all construction and operation of their equipment. Performance advantages include:—

(1) Non-overloading power characteristic. A flat power curve permits the impellers to run at any operating point with the same motor. The motor need not be changed for operation in another system.
(2) Higher efficiency than direct drive centrifugals when applied in warm air furnace or air conditioning applications.
(3) It permits the use of low cost motors for an extended range of performance.
(4) The completely balanced air flow (there are no motors in the air inlets) contributes to good air distribution at the outlet.

Construction advantages:—

(1) Symmetrical motor support. The motor is properly supported at its c.g. There is no need for special shipping brackets. The motor can be installed and serviced with ease. In addition, equalized loading of the motor bearings provides longer bearing life.
(2) The unit is narrower than an equivalent centrifugal blower unit.
(3) Motor and fan are resiliently mounted. (221)

Automatic micrometer

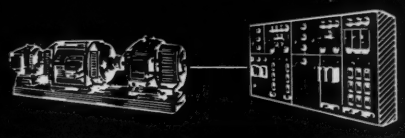
A new digital read-out automatic electronic micrometer is now being manufactured by the **J. W. Dice Company,** for precision measurement of fragile or compressible non-conducting materials and parts.

This motor-driven model JDR eliminates all operator discrimination other than reading the counter when contact with the work is automatically signalled. The counter has large, easy to read numerals with the last wheel reading in 20 millionths. The reading is the same no matter who pushes the switch.

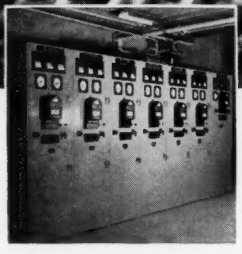
Pressure on the work can be set for a negligible amount if the work is extremely fragile or compressible.

The instrument is a true direct reading micrometer and is not to be confused with comparators. The screw thread micrometer as a direct measuring instrument has long been recognized for its important advantages. (222)

Continued on page 84



BEPCO



With 'Switchgear' too – you need green fingers

Given the same soil, the same fertilisers, the same sunshine and rain; using apparently, identical methods; two gardeners do not get identical results. One gardener grows perfect bloom in profusion but, try as he will, he can never tell you exactly how he does it. We say he has green fingers. But what really seems to have happened is that much he has learned over the years has become so completely part of himself that he does the right thing instinctively. Something of the same kind seems to happen in engineering — with a whole works playing the gardener. It is not a question of craftsmanship in the old sense, for it occurs even on a production line; but in a works that has been making switchgear for instance, for years the right decision seems 'natural', being based on knowledge that is so much a part of past experience that it is taken for granted. This is one reason why a name with a long history can still mean so much.

FOR THE FINEST IN QUALITY AND PERFORMANCE CONSULT . . .

BEPCO CANADA LIMITED

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Prove by comparison tests that Parker O-rings seal better, last longer

Comparison tests will prove it. You can't *see* the difference. You can't *feel* it. But in *use,* Parker O-rings seal better, last longer.

Why? Because Parker O-rings are precision-molded of superior compounds developed by exhaustive research and experimentation. From Parker, you get the *right* O-ring for your *specific* application.

These trouble-free, leakproof seals are carefully evaluated for elongation, tensile strength, compression set ratings, resistance to oils, fuels, chemicals and temperature extremes. Whatever your requirements, Parker can supply the O-rings you need.

Parker O-Lube is especially formulated for lubrication requirements.

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Please send: ☐ O-ring Size Catalog No. 5701
☐ O-Lube Catalog No. 5840

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PARKER RUBBER DIVISION

Parker Hannifin
creative leader in fluid systems

Dry compressed air

(Continued from page 42)

from the air before use, a moisture separator is usually installed in the service line immediately ahead of the point of use. The air will then be practically dry.

Completely dry air can be obtained by reducing the dewpoint of the air (before distribution) to a value lower than the lowest temperature that the air will encounter in any part of the system.

Dewpoint can be defined as the compressed-air temperature below which water vapor begins to condense. If air is cooled below this temperature, water will be precipitated, and the dewpoint will stay at the lowest temperature to which the air has been subjected, provided that all the released water has been trapped out. This water must be removed, or it will vaporize again and raise the dewpoint.

An aftercooler can be used for dewpoint reduction. It consists of a nest of tubes in a shell. Compressed air is passed through the tubes and cold water is circulated over and around them. Aftercoolers may be mounted either vertically or horizontally for best space utilization or simplest piping. Water flows through the aftercooler in a direction counter to the air flow, so that the water inlet is at the air discharge end of the cooler. Automatic valves may be used to control the water flow. Discharge water from the aftercooler can then be used for compressor cooling. This slightly cooled water is better for this service than extremely cold water.

Air from the aftercooler enters the head of the receiver and the drops of water fall to the bottom, where they are drained out. A thermometer in the cooler outlet enables the operator to make certain that the correct amount of cooling water is being used. For protection, a pop safety valve must be placed between the compressor and the aftercooler, or any possible source of obstruction in the air lines.

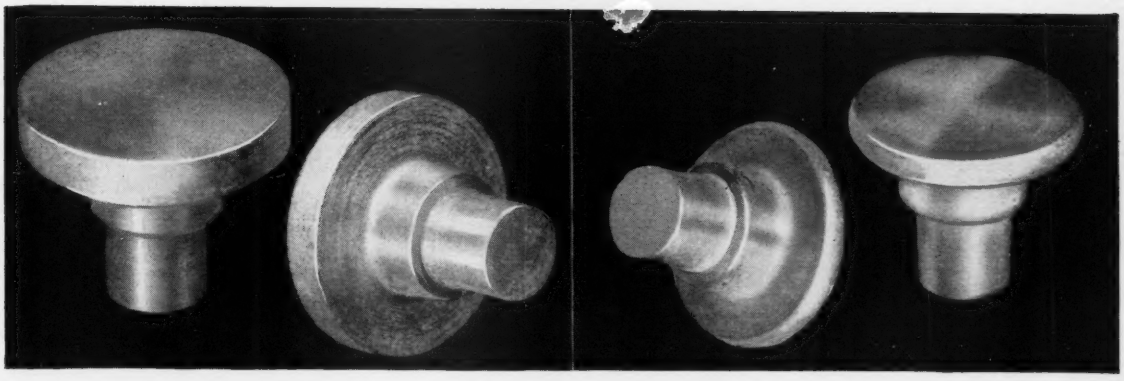
The proportions of a good aftercooler are such that the air will be cooled to within 10 F of the cooling water temperature with a water flow of 1 to 2 gal per min for each 100 cu ft of air that is compressed to 100 psi. With an aftercooler designed according to this principle, water at 75 F or below would be adequate to dry the air completely in the previously described sandblast installation, where 2 gallons of water per hour were condensed on a hot, humid day.

Any water carried through the receiver can be removed by a moisture separator. The type illustrated consists of a cylindrical chamber into which the air flows tangentially, producing a swirling motion. The drops of water (they are heavier than air) are thrown to the walls. ★

TO SAVE ON FASTENERS

Standardize your Specials

THROUGH STELCO COLD HEADING



Machined "Special" . . . slightly redesigned as a Cold Headed "Standard"

The simple Flat Head Shoulder Rivet shown on the left above (enlarged), was slightly amended as seen on the right, to permit production by cold heading instead of by machining. The elimination of scrap loss, combined with increased speed of production, brought a saving of 80% to the purchaser.

Pictured below are several other "specials" standardized by Stelco with considerable cost reduction.

57121.B

Result - 80% Savings!

Stelco's modern bolt-making facilities, plus the services of Specialty Fastener Representatives, offer you three ways to save on "special" fasteners —

FIRST — Many types of contoured parts can be produced by cold heading more economically than by machining. Not all savings are as impressive as the one illustrated above, but *cost reductions in the region of 40% are not uncommon* and are often accompanied by minor redesigning which adds to the strength of the part. Secondary operations, such as thread rolling or cutting, knurling, extruding, flattening, piercing, drilling, broaching, and bending are also provided for in Stelco's facilities.

SECOND — Stelco will carry as stock items your long-run repetitive "specials" — giving you a ready source of supply and the benefit of large-quantity prices.

THIRD — Your "special" requirement might already be in stock as a Stelco "Standard" — or possibly an existing "special" could meet your needs. In either case you would realise a saving.

Why not ask Stelco's Engineers to examine *your* "specials"? If they are adaptable to production by the cold heading process your cost reductions will be substantial. Any Stelco Sales Office is at your service.

THE STEEL COMPANY OF CANADA, LIMITED

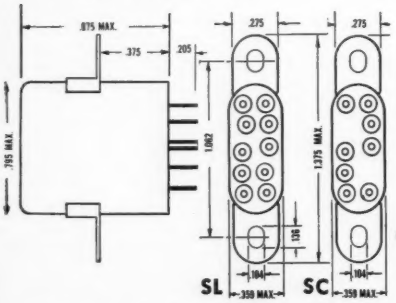
Executive Offices: Hamilton and Montreal

Sales Offices: Halifax, Saint John, Montreal, Ottawa, Toronto, Hamilton, London, Windsor, Winnipeg, Edmonton, Vancouver. J. C. Pratt & Co. Limited, St. John's, Newfoundland.

CRYSTAL-CASE SIZE! PERMANENT MAGNET DESIGN.
SHOCK: 100g. VIBRATION: 30g 55 TO 2000 cps. NO CONTACT OPENINGS.

SC NON-LATCHING TYPE—This micro-miniature relay sets new standards —in design, in performance, in reliability. Yet the SC conforms to standard dimensions and circuitry and may be used to replace ordinary crystal-case relays. A permanent magnet in the structure provides *at least twice the contact pressure found in relays of comparable size.*

SL LATCHING TYPE—Unique magnetic latch assures exceptional contact pressure. A 1 watt, 3 ms. pulse to either coil transfers contacts. Transfer time is only 0.5 ms. Has the same exceptional shock and vibration characteristics as the SC.



SC and SL Series Engineering Data

Operate Time: 3 MS. max. with 550 ohm coil @ 24 V. DC. (SL: 630 ohm coil at 24 V. DC).
Transfer Time: 0.5 MS max.
Terminals: (1) Plug-in for microminiature receptacle of printed circuit board. (2) Hook end solder for one #20 AWG wire.
Enclosure: Hermetically sealed.
CONTACTS: Arrangement: 2 Form C.
Material: Gold flashed palladium.
Load: 2 amps @ 28 V. DC, resistive; 1 amp @ 115.V. AC, resistive.
Pressure: SC—13 grams min.; SL—16 grams min.
COIL: Power: Approx. 1.0 watt at Nominal Voltage.
Resistance: SL—40 to 1400 ohms; SC—35 to 1250 ohms.
Duty: Continuous.
MOUNTINGS: Bracket, stud and plug-in.

GENERAL: Insulation Resistance: 10,000 megohms, min.
Breakdown Voltage: 1,000 V. RMS.
Shock: 100g.
Vibration: 30g 55 to 2000 cps.; 0.195" max. excursions from 10-55 cps.
Temperature Range: -65°C. to +125° C.
Weight: 17.5 grams (5/8 oz.).

P&B Representatives in Canada: Aeromotive Engineering Products, Montreal
A.T.R. Armstrong, Ltd., Toronto • Charles L. Thompson, Ltd., North Vancouver

Potter & Brumfield, inc.

PRINCETON, INDIANA · SUBSIDIARY OF AMERICAN MACHINE & FOUNDRY COMPANY
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Book Department

Direct Current Fundamentals (2nd edition) by Joseph J. DeFrance (Prentice-Hall, Inc.).

This new edition of DeFrance's popular text can now be used by students in the "power" field, as well as by those in electronics. It contains much new material on power, such as additional problems with power applications, earlier introduction to the use of instruments, electrical-to-mechanical power conversion and efficiency, electrical energy, Kelvin bridge, Kirchoff's laws and other new information. A simplified treatment, the text covers all direct current principles and the more important applications.

It sells for $4.25.

• • •

British Internal Combustion Engine Research Association: Handbook on Torsional Vibration. Edited by E. J. Nestorides (Cambridge University Press).

Because of the trend toward higher power output, increased running speeds and the maximum utilization of engineering materials, designers now have to consider in great detail the torsional vibration conditions of engines and the machines they drive. Rule-of-thumb formulae are being replaced by more accurate data obtained from recent research.

Work in BICERA laboratories (and the accumulated experience of member firms of the association) are used in this handbook as the basis for an engineering approach to the various problems associated with torsional vibration. It gives much new information, including exact formulae, design procedures, specifications and methods (such as that for crankshaft-stiffness evaluation, taking account of the various features of crank-webs).

This information is essential to mechanical, marine, aero engine and automobile engineers, designers of reciprocating engines and their driven machines (for example, gear-wheel makers, coupling, brake, generator and other manufacturers), instrument engineers and development engineers. It is also a reference book for consulting engineers, stress analysts, insurance companies, shipowners, marine superintendents, railway authorities, the government departments which enforce specifications and post-graduate researchers in engineering laboratories.

The cost of the book is about $17.00.

Analytical Design of Linear Feedback Controls by George C. Newton, Jr., Leonard A. Gould and James F. Kaiser.

What does the phrase analytical design mean? In this book, it is identified as the design of control systems by application of the methods of mathematical analysis to idealized models which represent physical equipment. Taking as their starting point the system specifications, the authors include descriptions of the input, the disturbances and the desired response. They also include a statement on the basis on which the system performance will be judged; this statement is in the form of a performance index. The design objective is to minimize (or maximize) the chosen performance index. Analytical design theory, the authors show, is a presentation of the ways and means for accomplishing this objective.

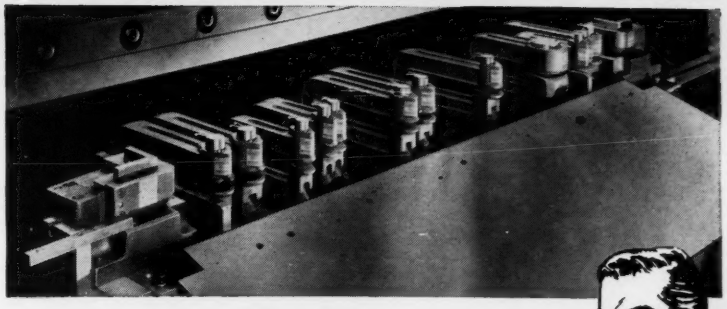
Included is a comprehensive discussion of the analytical design procedure for two performance indices. For systems subject to transient input signals, the integral-square error is used as a performance index. For stochastic input signals, on the other hand, the mean-square error is used. The price is $12.00.

Suggestions for designers of electronic equipment, 1957 edition (U. S. Navy Electronics Laboratory).

This booklet was prepared by the Engineering Division and the Human Factors Division of the U. S. Navy Electronics Laboratory for distribution (at the 1957 Western Electronic Show and Convention) to representatives of electronic equipment manufacturers. Its purpose is to help engineers develop equipment that is simpler, more usable, more reliable and more economical. Its objective is to obtain savings in materials and engineering effort, more effective systems, and a more efficient military force.

It is hoped that the suggestions given will serve as a handy check list for as many engineers as possible. Although these suggestions are specifically intended for electronics equipment developed for the Bureau of Ships, most of them apply to all types of military electronics equipment.

The first section, "Common faults found in electronic equipment manufactured for the Bureau of Ships," presents specific findings of the Evaluation Branch of the Laboratory. The section, "Technical suggestions for designers," is taken from Bureau of Ships specifications and other basic data sources. "Human engineering suggestions for designers" are the recommendations of the Human Factors Division of the Laboratory. "Points for proper parts application" are derived from ASESA publications with revisions by the NEL Reliability and Standards Branch.



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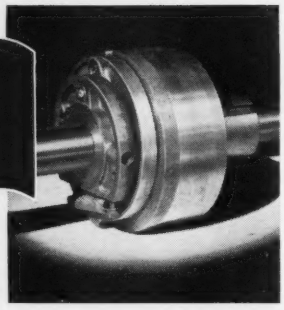

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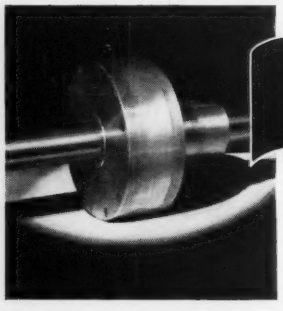

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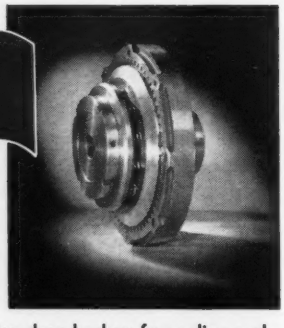

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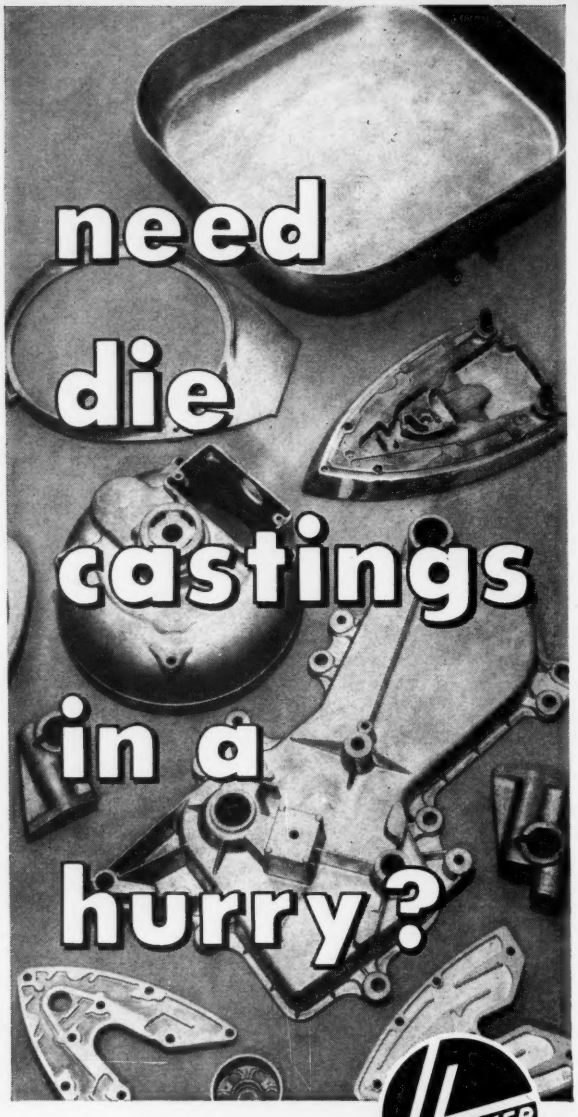

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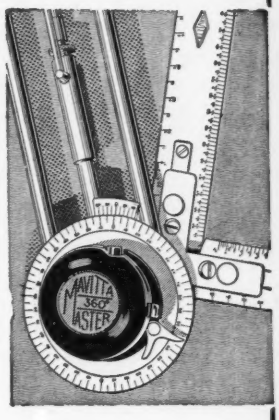

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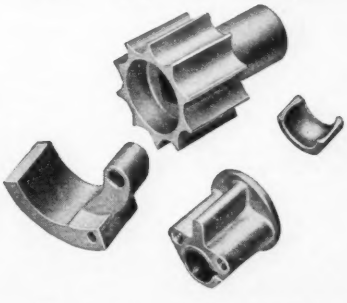

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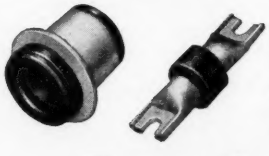

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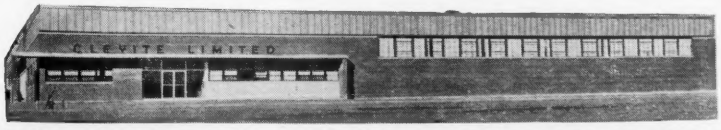

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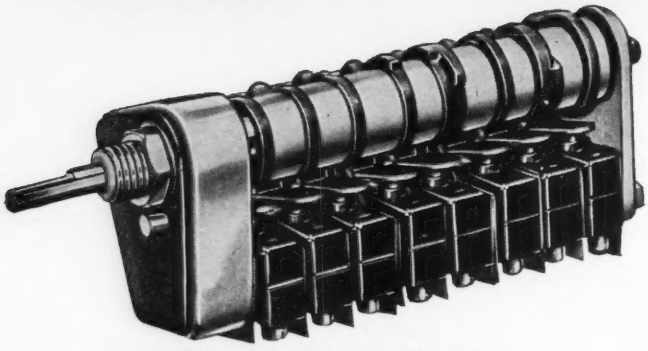

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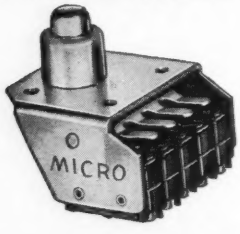

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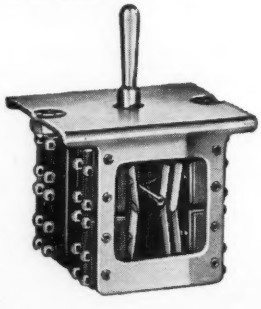

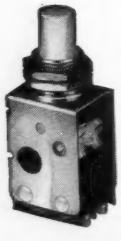

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(Continued from page 74)

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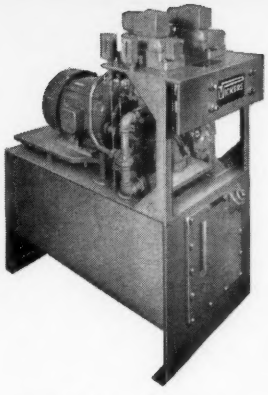

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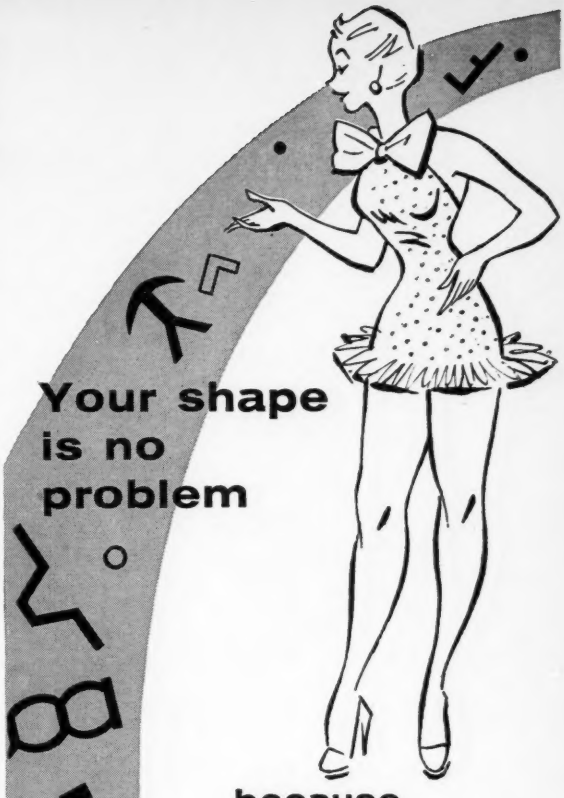

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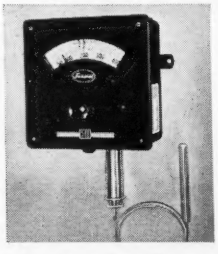

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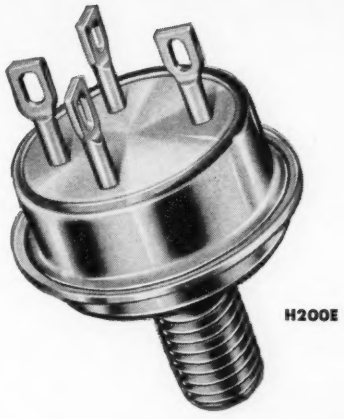
Honeywell develops

FIRST POWER TETRODE!



Faithfully reproduces input signals— frequency response improved 50%!

Now, for the first time, you can get a transistor that gives low audio distortion, high efficiency and high power output—with high impedance drive and without feed-back.

Also, *Thermal Stabilization* of the Power Tetrode is achieved more easily than with triode transistors because of the second base connection. This stabilization can be achieved even with high impedance drive, allowing high temperature operation of direct coupled circuits using Power Transistors.

The H200E is a germanium PNP alloyed junction power transistor designed to operate on 28-volt systems with currents up to 10 amperes. Its thermal resistance is less than 1 °C/watt.

The Power Tetrode is available in sample quantities. Get complete information by writing Honeywell, Toronto 17, Ontario.

Honeywell

H HONEYWELL *First in Controls*

Editorial

Some of our plans for next year

In the course of a week, you would be surprised how many press releases, catalogues and brochures come into the office. Much of this, after editing, is used in the departmental pages, such as Reports, People, New Products, Design News in Pictures and so forth. Slightly more interesting items go into the Ideas Round-up, while some may spark sufficient interest for us to go out and get more information or get an article written by a specialist engineer.

Articles scheduled for 1958 include a summary on light alloy castings (aluminum and magnesium) showing the different types (sand, die, shell mold, investment) and useful information for the design engineer; blind fasteners, such as Cherry, Pop, Huck and so forth; plastic tools, thermostat and thermocouple design; design improvements by using gray iron castings; nylon applications; permanent magnet types; and so forth.

Another Canadian achievement

We recently had the opportunity of inspecting some of the components that will be used in the eight umbrella-type water wheel generators for the St. Lawrence Seaway.

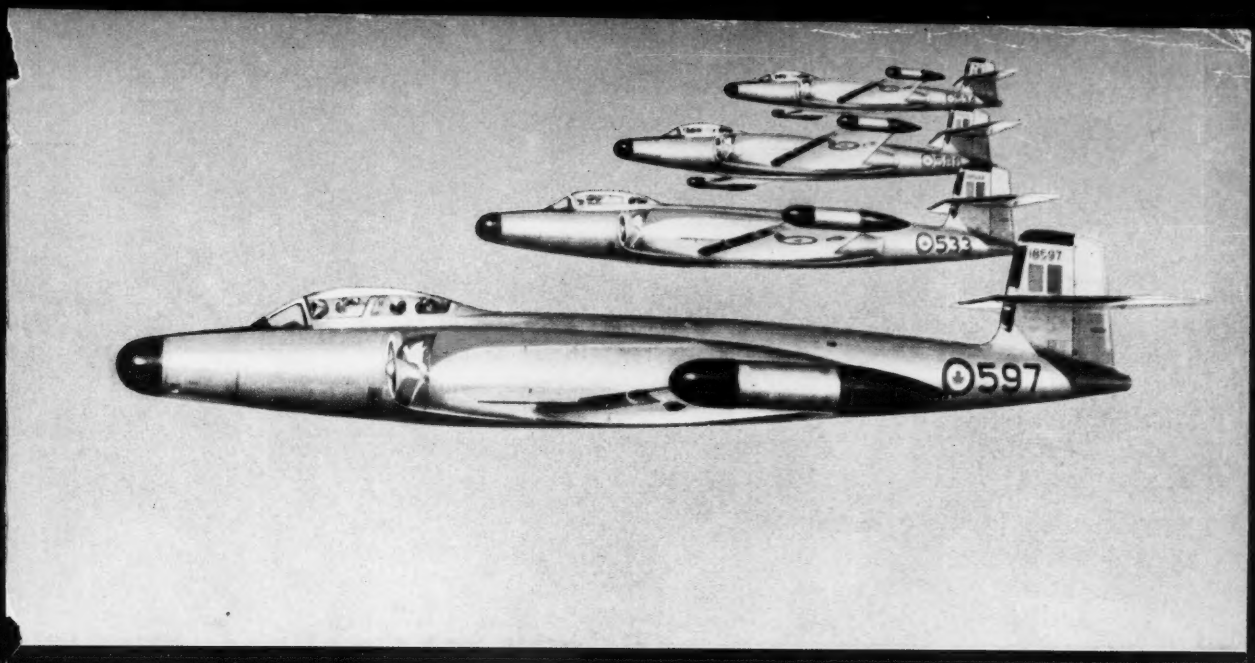
The generators are rated at 60,000 kva, 75,000 hp and 13,800 volts. They are the result of the joint design efforts of Canadian Westinghouse and English Electric.

The heaviest single component in them is the vertical shaft, each of which weighs 58 tons. These are the largest shafts ever made by Canadian Westinghouse.

A special feature of the design is the Kingsbury-type bearing which has shoes that tilt as the load comes on them, thus forming a tapered oil film between the shoe and the runner.

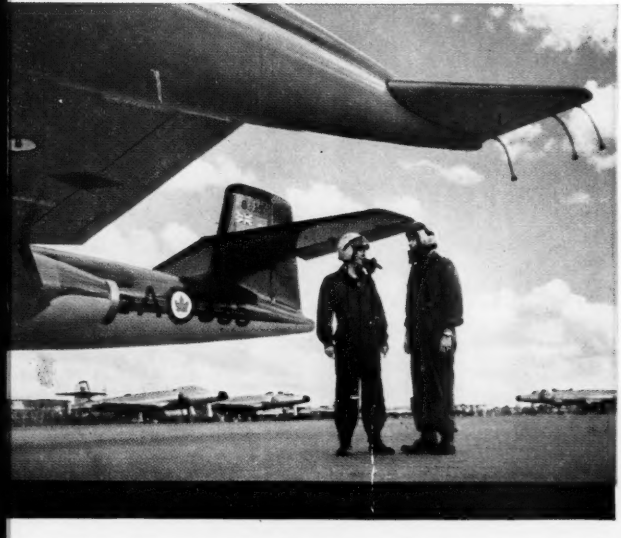
Further details of these interesting generators will be given in Design Engineering later.

William Morse.



ON GUARD IN CANADA...IN EUROPE...

AND FOR THE FUTURE...THE AVRO ARROW



From the first flight of the Mark I CF-100 in 1950, the development and performance of this all-weather interceptor for the Royal Canadian Air Force has won for it the role of front line defender in North America and Western Europe.

The Avro Arrow, recently unveiled, begins an intensive pre-flight testing program. Under development for the interception role of the RCAF in the new North American Defence Command, the Arrow will have supersonic mission capabilities.

AVRO AIRCRAFT

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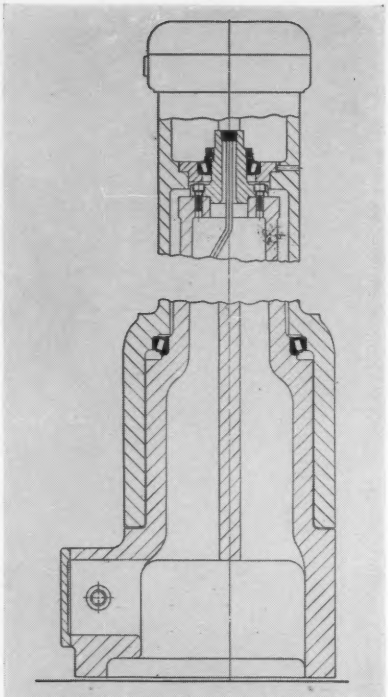
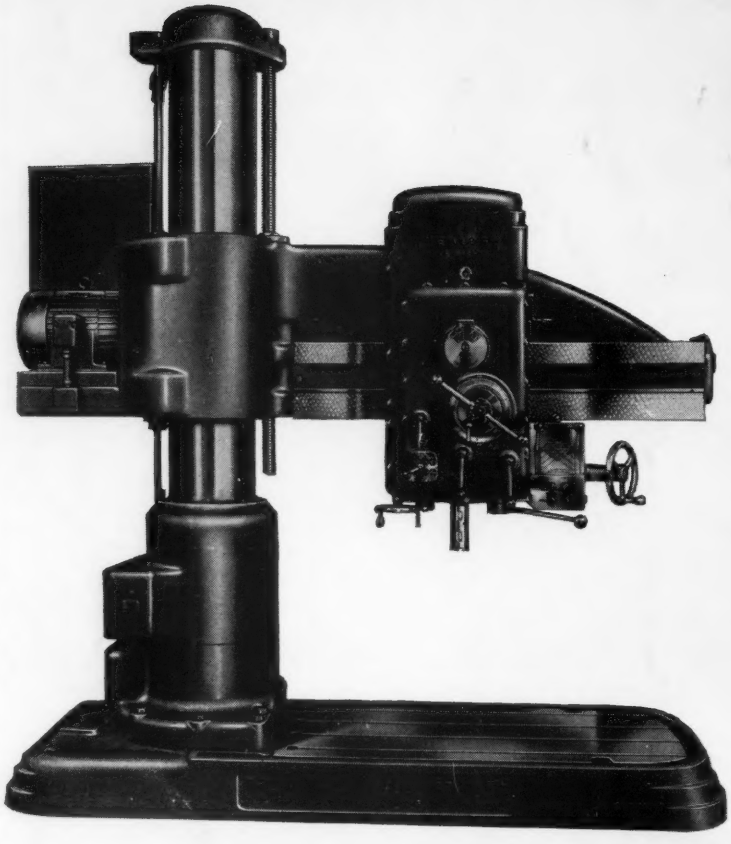


How **THE AMERICAN TOOL WORKS CO.** mounts column of 32-speed Hole Wizard Radial on 2 Timken bearings to increase rigidity 50%. Spindle and transmission use 11 more Timken bearings.



New radial drill has 50% more rigidity with column mounted on Timken bearings

TO resist stresses and cut arm deflection in half, the column unit of this new 32-speed Hole Wizard Radial is mounted on two Timken tapered roller bearings. With a large, pre-loaded Timken bearing at top and bottom, The American Tool Works Company gives the column and sleeve the rigidity of a single piece. This results in greater accuracy and longer cutting tool life, permits higher speeds and coarser feeds.

HOW COLUMN IS HELD RIGID. Timken bearings keep the column unit in positive alignment. Their tapered design lets them take both thrust and radial loads in any combination. And full line contact between rollers and races gives Timken bearings load-carrying capacity to spare.

HEAVY SHOCKS ABSORBED. Rollers and races of Timken bearings are case-carburized to give them hard, wear-resistant surfaces over tough, shock-resistant cores. They reduce maintenance.

FRICTION VIRTUALLY ELIMINATED. Timken bearings run smoother, last longer, because they're geometrically designed for true rolling motion—and precision-made to live up to their design.

So whether you buy or build machines, it pays to specify bearings trade-marked "TIMKEN". The Timken Roller Bearing Company, Canton 6, Ohio. **CANADIAN PLANT:** St. Thomas, Ontario. Cable address: "TIMROSCO".

This symbol on a product means its bearings are the best.

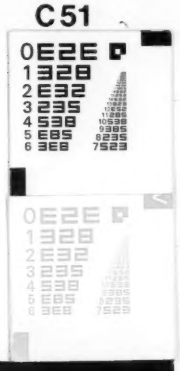
TIMKEN *Made in* CANADA

TRADE-MARK REG. IN CANADA AND U. S. PAT. OFF.

TAPERED ROLLER BEARINGS

FOR CANADIAN INDUSTRY

NOT JUST A BALL ○ NOT JUST A ROLLER ▭ THE TIMKEN TAPERED ROLLER ▭ BEARING TAKES RADIAL ◫ AND THRUST ⊣◫⊢ LOADS OR ANY COMBINATION ⊣◫⊢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